



DREXEL UNIVERSITY COLLEGE OF ENGINEERING

## SENIOR DESIGN PROJECTS 2013



## SENIOR DESIGN

The Senior Design three-course sequence is intended to simulate a professional work environment, to provide experience working in a group on an open-ended problem and to develop information gathering and communication skills. Substantial interaction between students, faculty and industrial and governmental institutions is an integral part of this experience.

Engineering students make up the majority of the senior design teams but the sequence is open to seniors in any discipline. During the fall the students form their teams, select an area of interest, then extract and explicitly state their design problems and methods of solution in formal proposals to the Design Faculty. The teams develop their own solutions during the Winter and Spring, the culmination of which is a formal report of the results. The faculty encourages the students to place as much emphasis upon the process of defining the problems and developing the solutions as is placed upon the actual end products. To reflect that concern, proposals, progress reports and final reports are required in both written and oral formats.

The Senior Design Final Presentations are our way of providing a forum in which the project engineers (the students) can communicate their results to the community.

Adam Fontecchio  
Associate Dean  
Senior Project Design Coordinator  
College of Engineering

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CBE-02 TERRAFORMING MARS TERRAFORMING MARS

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MEM-04 AUTOMATED MIXED DRINK DISPENSER

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MEM-07 EFFICIENT EASY-ACCESS REFRIGERATOR

MEM-08 DESIGN AND CONSTRUCTION OF A SUPERCRITICAL FLUID CO<sub>2</sub> FLOW REACTOR

MEM-09 DESIGN, FABRICATION AND INSTRUMENTATION OF A THERMOACOUSTIC HEAT ENGINE

MEM-10 ADAPT CATAPULT DEAD LOADS TO USE NOSE GEAR LAUNCH BAR

MEM-11 UNMANNED AERIAL VEHICLE FOR INFRASTRUCTURE EVALUATION

MEM-12 DESIGN OF AN ELECTROCHEMICAL FLOW CAPACITOR TEST SYSTEM

MEM-13 MOTORCYCLE LAND SPEED RECORD: FLYING DRAGONS II

MEM-14 AUTOMATED NETWORKED TRANSPORT SWARM, STEERING TEAM

MEM-15 AUTOMATED NETWORK TRANSPORT SWARM (ANTS) – POWER SUPPLY

MEM-16 CHARACTERIZATION OF A HYBRID OR ELECTRIC DRIVE SYSTEM FOR A MOTORCYCLE

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MEM-18 LOW WIND VELOCITY ELECTRICITY GENERATING TURBINE

MEM-19 DIRECT REPLACEMENT LED MODULE FOR VEHICLE HEADLIGHTS

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MEM-26 SUSTAINABLE DEVELOPMENT FOR BO KLUA THAILAND: CLEAN WATER

MEM-27 SUSTAINABLE DEVELOPMENT FOR RURAL THAILAND: IMPROVED RICE PLANTER

MEM-28 ENHANCED MANUFACTURING

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MEM-37 THE DESIGN AND FABRICATION OF A FORMULA SAE CHASSIS

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- MSE-01 THERMOMECHANICAL PROCESSING OF AA5083 AND THE RESULTANT IMPACT ON CORROSION RESISTANCE
- MSE-02 MONITORING AND IDENTIFICATION OF PROGRESSIVE DAMAGE IN AEROSPACE COMPOSITES USING NON DESTRUCTIVE TESTING
- MSE-03 THE EFFECT OF NICKEL DISTRIBUTION ON THE HARDENABILITY OF POWDER METAL COMPACTS
- MSE-04 DEVELOPMENT OF QUANTUM DOT INTEGRATED LIGHT-EMITTING DIODES FOR SOLID-STATE WHITE-LIGHT APPLICATIONS
- MSE-05 CORE-CLAD ELECTROSPUN FIBERS FOR CONTROLLED DRUG RELEASE APPLICATIONS
- MSE-06 ADSORPTION OF ANTIBIOTICS ONTO NANODIAMOND PLATFORMS
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- BME-01 PEPTIDE-BASED DELIVERY SYSTEM USED FOR TAGGING SYK TYROSINE KINASE BIOMARKER IN SKIN CANCER AND DEVELOPMENT OF A HYPERSPECTRAL IMAGING DEVICE TO DETECT THE BIOMARKER
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## **CAEE-01**

### **CHARLES A. PANKOW DESIGN COMPETITION: INTEGRATED DESIGN OF AN ELEMENTARY SCHOOL IN READING, PA**

**Advisor:**      *Prof. Robert Brehm*

**Team:**

Anthony Bifano	Architectural Engineering
Kayleigh Houde	Architectural Engineering
Rohit Shah	Architectural Engineering
Alyssa Stein	Architecture
Stephen Wayland	Architectural/Civil Engineering
Kanishk Yadav	Civil Engineering

The school board of Reading, Pennsylvania requested that a new elementary school be designed at a fictional site located along North 13<sup>th</sup> St, in Reading. The school building is approximately 91,000 square feet with a 18,000 square foot natatorium space located in the lower level of the building. Design challenges for the project included; poor site soil conditions, inclusion of a green roof on the project, obtaining LEED certification, and designing for a high degree of flexibility for the future of education. The final design addressed all of the client's requirements, and was evaluated on a Life Cycle Cost basis to ensure maximum value. Final design features included; precast hollow core flooring elements, a tensile fabric roof system, a dual functionality PV/ thermal solar system, greywater capture and reuse, and a unique sewer source condenser mechanical system to provide heating and cooling to the building.

## **CAEE-02**

### **A NEW HOME FOR THE COLLEGE OF ENGINEERING**

**Advisor:**      *Dr. Michael Waring*

**Team:**

Taylor Derr	Architectural Engineering
Tucker Faherty	Civil Engineering
Samuel Martin	Civil Engineering
Matthew Morabito	Architectural Engineering
David Simon	Civil Engineering

Verticore Engineering has developed a building complex at 3101-3157 Market Street to be used by the Drexel University College of Engineering. The contents of the building complex are mixed-use, including classrooms, laboratories, retail space and corporate partner space. The space for corporate partners allows for collaboration between students, faculty, and prominent leaders in the engineering field; a goal which was highlighted in President Fry's 2012 Strategic Plan. To utilize the mixed-use space properly, the building complex has been divided into two separate buildings, which connect only on floors four through six. Verticore engineers assessed several criteria, including site constraints, efficiency, and environmental considerations in order to resolve the design of this building complex. Ultimately, designs were completed for the building skin, foundation, structure, HVAC system, and storm water system and have since been successfully constructed in conjunction with one another.

*Sponsor: Drexel University, Student Life and Administrative Services, Department of Real Estate*

### **CAEE-03**

#### **MANAGING STORMWATER WITH GREEN INFRASTRUCTURE ON DREXEL'S CAMPUS**

**Advisor:**     ***Dr. Franco Montalto***

Team:

Ryan Fucci	Civil Engineering
Megan Gribb	Civil Engineering
Ge Pu	Environmental Engineering
Nicole Quinlan	Civil Engineering

Due to the changes in Philadelphia's stormwater billing structure, Drexel University is responsible for managing the first inch of runoff on all redeveloped sites as well as paying stormwater fees relative to the impervious surface area on campus. The objective of this project was to use a triple bottom line approach in reducing the amount of stormwater runoff on Drexel's campus by incorporating green infrastructure.

Several site alternatives were evaluated by stormwater management potential and value to campus to determine a final site location between Towers and Calhoun Residence Halls.

Constraints of the design included the existing master plan, spatial limitations onsite, stormwater diversion from existing buildings, and Philadelphia stormwater regulations. Different green infrastructure alternatives were assessed for feasibility before a final design of three rain gardens was developed. An educational monitoring facility was proposed within the design to allow students and visitors to better understand rain gardens.

### **CAEE-04**

#### **MANTUA GREEN RESOURCE CENTER**

**Advisors:**     ***Dr. Eugenia Ellis***

Team:

Mitchell Butler	Architectural Engineering
Issa Haddad	Civil Engineering/Architectural Engineering
Ronny Mikhail	Civil Engineering/Architectural Engineering
Junwah Ng	Architectural Engineering
Bolutiwi Odulaja	Civil Engineering

At the 37th Block on Mantua Avenue, there is currently a cluster of abandoned lots destined for redevelopment. The group has partnered with the Philadelphia Horticultural Society to develop a proposal to use this space as a Green Resource Center (GRC) for the Mantua community. The GRC would provide a place for growing and selling produce, with a heavy emphasis on community involvement. Designed elements include a greenhouse and hoophouse, a community harvest and wash station, a community education center, and parking facilities. Furthermore, the group desires to attain net-zero energy usage, and net-zero runoff for the site. The design of these facilities requires an integrated approach to all site systems, including solar panels, rainwater retention basins, and passive wind and solar design. Because of its small size, the project allows the group to closely examine the feasibility of designing a self-sustaining facility that will meet social and economic needs of the community.



**CAEE-05  
DREXEL UNIVERSITY STUDENT UNION CENTER**

**Advisor:**      *Prof. James E. Mitchell*

Team:

Andrew Cardamone	Architectural Engineering
Nick Christie	Architectural Engineering
Vincent Farace	Architectural Engineering
Dianna Guidone	Architectural Engineering

Currently Drexel University does not have a proper student union for the students of the university to call their own. The Creese Student Center is currently used for faculty offices and a very small lounge area. Penguin Engineering has designed a new student union center to be used for all current and future students of the university. Located at 32nd and Market the center will include large study areas, lounge space, business centers, conference rooms, a retail space, a 500 person auditorium, and a multipurpose penthouse. The space will have large enough areas that will allow for customization of the spaces in the future if need be. This center will give the students a place to call their own and come together to collaborate on projects, relax, and plan events. The goal for this project was to create a space where all students could come together and be a part of this university.

**CAEE-06  
MALABO FLOATING COMMUNITY SCHOOL PROTOTYPE IN ZAMBIA, SOUTHERN AFRICA**

**Advisor:**      *Dr. Joseph Martin*

Team:

Elda Cifligu	Civil Engineering/Architectural Engineering
Maria Gabriela Gonzalez	Civil Engineering/Architectural Engineering
Kevin Njinga	Civil Engineering
Sabrina Villanti	Civil Engineering

This Senior Design Projects aims to solve a continuing problem that all the surrounding communities in Malabo, Zambia face. The annual flooding problem along the Zambezi River interrupts the performance of the already inadequate infrastructure in the area. One of the consequences is that 250 children miss 4-6 months of school and do not follow a standard curriculum. The option of leaving for higher elevated grounds is not convenient because of the isolated location of the communities and the agricultural benefits due to the floods. After considerable research through focus groups, with the help of UNICEF, the team considered to develop a prototype that will help resolve the flooding problem in Malabo, Zambia, as well as every community in need. The team proposed to construct a shipyard in an urban area to design and build modular units on barges that will transferred to the designated areas in need by floating them through the river. The barges will be anchored to piles that have been placed at the floodplains, ultimately offering a flood-proof infrastructure that will be used all year around.

**CAEE-07  
GOLDTEX BUILDING REPURPOSING**

**Advisor:**      *Dr. Joseph Mullin*

Team:

Jason Booty	Civil Engineering
John Krafchik	Civil Engineering
Matthew Mazalewski	Civil Engineering/Architectural Engineering
Matthew Watson	Civil Engineering

This project consists of overhauling the old Goldtex building at 12th and Wood St. in Philadelphia into new residential living space and ground level retail. The abandoned factory constructed in the early 1900's has undergone little in upgrades over the years and the failed attempts to renovate the building have left it in an even worse state of repair. During the design process the team worked to determine the current state of the building, the necessary repairs, and developed a new overall plan for the renovated building. Drawings have been created containing condo floor plans, retail and lobby floor plans, utility locations, and utility layout diagrams for the building. Structural and foundation analysis were also considered. The owner and city can both benefit from this project. The once vacant building can now bring in profit and increase area land values.

**CAEE-08  
MANTUA GREEN RESOURCE CENTER**

**Advisor:**      *Dr. Eugenia Ellis*

Team:

Derek Clery	Architectural Engineering
Stephen Foss	Civil Engineering/Architectural Engineering
Kristyn Lemons	Architectural Engineering
Katherine Sitter	Architectural Engineering

The Pennsylvania Horticultural Society, in partnership with Drexel University, has expressed interest in acquiring a two and half acre site of vacant land in the Mantua neighborhood of West Philadelphia. They plan to develop the site into an urban farm and Green Resource Center, with the goal of providing the community with access to healthy fresh food and education on gardening and nutrition. The focus of this project is the design of the Green Resource Center, a 2000 square-foot building containing a large kitchen and classroom space for members of the community. The building will be constructed from recycled shipping containers that are incorporated into a Vierendeel truss system. Other highlights of the design include sustainable features such as daylighting, radiant heating and cooling, recovery air ventilation, photovoltaics, and a robust stormwater management system. Overall, the design incorporates sustainable features into a low-cost, low-maintenance design for the client.

**CAEE-09  
DREXEL HAGERTY LIBRARY ANNEX**

**Advisor:**      *Prof. Louis A. DaSaro*

Team:

Kelsey Brady	Architectural Engineering
Jared Hurwich	Civil Engineering
Anthony Kmush	Architectural Engineering
Michelle Martucci	Civil Engineering
Marissa Zaporta	Architectural Engineering

Keystone Associates has recently been hired to design an annex to the existing Hagerty Library on Drexel University's campus. The project site is currently a 9,600 square-foot parking lot directly south of the existing library. Currently, the Hagerty Library needs additional study space for the projected student body growth of Drexel University. The annex will meet the needs of the current student body by providing more study space, and the needs of the projected future student body by having the ability to expand. The foundations and columns of the Library Annex will be designed to accommodate vertical expansion to satisfy the future needs of the university. Therefore, as the student body at Drexel University increases, so will the available study space. Further, this building will follow the modern architectural image of Drexel's campus and will meet the Leadership in Energy in Environmental Design (LEED) gold standard.

**CAEE-10  
GREEN LANE BRIDGE PROJECT**

**Advisor:**      *Dr. Emin Aktan*

Team:

Sandesh Dev	Civil Engineering
Peter Falk	Civil Engineering
Thomas Fone	Civil Engineering/Architectural Engineering
Dong Lin	Civil Engineering
Sean Rahill	Civil Engineering

The Green Lane Bridge Project was a comprehensive evaluation and analysis of the Green Lane Bridge that yielded multiple intervention alternatives to increase the performance of the bridge. An in-depth, visual inspection report was developed that examined the structural system of the bridge as well as general maintenance items, operational performance and aesthetic aspects. The deficiencies identified by the inspection report were prioritized and repair options were analyzed. Analysis also included the creation of an interactive 3D model of the bridge to be supplied to the client and the global impact of construction on the Green Lane Bridge. The client (City of Philadelphia, Streets Department) was provided with multiple intervention alternatives were designed to increase operational performance, general maintenance, inspectability and durability of the Green Lane Bridge.

## **CAEE-11**

### **PORTABLE WASTEWATER TREATMENT FOR HYDRAULIC FRACTURING FLOWBACK IN THE MARCELLUS SHALE**

**Advisor:**     *Dr. Joseph Martin*

Team:

Patrick Morrow	Civil Engineering
Matthew Nelson	Civil Engineering
Ilya Sidorochev	Civil Engineering
Frank Stake	Environmental Engineering

Between 2005 and 2012, the number of unconventional natural gas wells “fracked” per year in the Pennsylvanian Marcellus shale went from less than 100 to over 1,700. These wells consume millions of gallons of water each, and produce hundreds of thousands of gallons of “flowback.” Flowback typically contains high levels of chlorides, metals, and radionuclides and is unsuitable for direct discharge to surface waters. The high levels of chlorides present in flowback have made it impossible for conventional wastewater treatment plants to treat the flowback for discharge. Since 2011, industry has been moving towards specialized, minimal treatment methods and re-use of flowback. The team’s solution was to use near site selective precipitation to minimize trucking costs and produce recycled flowback suitable for re-use as hydraulic fracturing fluid in order to minimize the release of contaminants to the environment and to reduce the demand for fresh water used in the fracking process.

## **CAEE-12**

### **FEASIBILITY ANALYSIS OF A FIXED LINK CROSSING THE LONG ISLAND SOUND**

**Advisor:**     *Dr. Joseph Martin*

Team:

Victoria Ciraco	Civil Engineering
John Dobbs	Civil Engineering
Katie Hammel	Civil Engineering
Alex Stavropoulos	Civil Engineering

It was determined that there is a need for a link from Long Island, New York to Connecticut. Traffic is a large problem on the three bridges that connect to Long Island and Interstate 95 in New York and Connecticut. The only other alternative is to take the ferry, which is costly and time consuming. The link will lessen traffic in existing bridges, and allow commuters from both states a much easier and more convenient route. It will also create jobs and businesses on either side of the link. It was found through research that the link needed to incorporate both bridge and tunnel technologies to complete the span. Analysis for man-made islands transitioning from bridge to tunnel sections was also done. Factors such as life safety and ventilation were carefully examined during the analysis of the structural systems. It was determined that the link is feasible, and the design process can begin.

**CAEE-13**  
**MOUNT PLEASANT CHURCH RETRO/ADDITION**

**Advisor:**     ***Dr. Eugenia Ellis***

Team:  
Eric Bobo, Jr                   Civil Engineering  
Frank Cimato                 Civil Engineering  
Elena Fravel                 Mechanical Engineering  
John Scanlon                 Civil Engineering  
Tak Tse                        Civil Engineering

The Mt. Pleasant/ Zion church on the 5800 block of Germantown Ave in Philadelphia has proposed an idea of expanding their church. They have their already existing church and an empty lot next to it to build the extension. The Church Family specifically asked for a new Entrance, Redesigned Interiors, Larger Congregation Area, A Designated Laboratory Area, A Daycare Area, and More Bathrooms and Storage Areas. The church is also on a severely strict budget; this has affected our design decisions. Our method of solution is to build in the empty lot around the existing building then remodel the existing building to the churches requirements. What we have developed so far is a plan of the new church, a construction cost and schedule, and the mechanical and energy systems that go along with it. Our project was important in presenting an on budget option to help the church and community grow.

**CAEE-14**  
**COMPREHENSIVE STORMWATER MANAGEMENT PLAN FOR NORTH WAYNE, PENNSYLVANIA**

**Advisor:**     ***Dr. Patrick Gurian***

Team:  
Garrison Carafa               Environmental Engineering  
Julio Guzman                 Environmental Engineering  
Zachary Hawkins             Civil Engineering  
William McClure             Civil Engineering

The North Wayne neighborhood of Radnor Township is prone to frequent flooding. A proposal to turn a neighborhood park into a detention basin has caused conflict among residents and new ideas were needed. This study identifies the source and amount of the runoff within the watershed, and then outlines possible design solutions to alleviate the flooding. These include the implementation of decentralized, “green” storm water management approaches, such as rain barrels and permeable pavements, as well as alternative detention basin designs that will preserve the park

## **CAEE-15**

### **REDESIGN OF MARKET & 32ND ST AND MARKET & JFK BLVD**

**Advisor:**      *Dr. Anu Pradhan*

Team:

Michael Cicoria	Architectural Engineering
Brendyn Durishin	Civil Engineering
Brian Mazzone	Civil Engineering
Christopher Pfeifer	Civil Engineering

The location of this project is at the center of Drexel University and links the residential areas to the educational buildings. With the increasing enrollment at the University the two intersections have exceeded their capacity for both vehicle and pedestrian traffic and a redesign is necessary. The stakeholders for this project include Drexel University administrators, students, professors, faculty, as well as local businesses, employees, local residents, and the City of Philadelphia. The method of solution chosen for the redesign of this intersection was to first redirect traffic on 32nd Street and the Lancaster Extension that provides access to 32nd Street from Market Street. Traffic south of the extension on 32nd Street will be eliminated and will be replaced by a pedestrian bridge that crosses over Market Street. The bridge provides ADA regulation ramps as well as stairs on the North and South sides of Market Street.

## **CAEE-16**

### **REINVENTING ONSITE WASTEWATER TREATMENT**

**Advisor:**      *Dr. Sabrina Spatari*

Team:

Andrew King	Environmental Engineering
Dan Sergison	Environmental Engineering
Ryan Sweeney	Environmental Engineering
Sebastian Zawierucha	Environmental Engineering

The goal of our project is to design a small scale onsite wastewater to potable water quality treatment system for a single family household. The total capacity of the designed system is 480 gallons, which is sized based on typical domestic water usage for four people. Potable water quality will be met by primary and tertiary treatment processes. Primary treatment; coagulation, flocculation and sedimentation, will take place in a batch reactor sized based on the 480 gallons. Tertiary treatment processes are as follows: sand filtration, reverse electrodialysis, and chlorination. These treatment processes guarantee potable water quality and therefore do not limit the reuse of the water. The defining features of this design are its small footprint and limitless application of the treated effluent.

## **CAEE-17**

### **EASTWICK NEIGHBORHOOD FLOOD CONTROL DESIGN**

**Advisor:**     ***Dr. Paul Block***

Maria Lorena Alvarado	Civil Engineering/Architectural Engineering
Dylan Kahle	Civil Engineering
James Marks	Civil Engineering

The Eastwick neighborhood is located on the southwest section of Philadelphia, Pennsylvania and it covers an area of 8.95 square miles. Historically, Eastwick was comprised of nearly 6,000 acres of marshland until it was dredged in the 1920s due to construction plans in the surrounding areas. Our point of interest is the George W. Pepper Middle School, which is situated in one of the lowest elevation points in this neighborhood. During large-scale precipitation events, this area experiences flooding due to the low elevation and poor infiltration qualities. The scope of this project is to design and establish an improved storm water management system that will alleviate the flooding in the area surrounding the school. Following thorough analysis, the final design incorporates the most enduring and cost effective resources that will satisfy the needs of the residents of Eastwick.

## **CAEE-19**

### **ULTRASONIC ANTIFOULING IN SEAWATER INTAKES**

**Advisors:**     ***Dr. Ivan Bartoli***

Team:

Mohammad Al Naimi	Mechanical Engineering
Ibrahim Alkhamis	Civil Engineering
Husain Khajah	Civil Engineering

Our goal is to develop a system that inhibits marine growth in seawater intakes. The seawater intake that we are targeting is an onshore submersed structure that is located close to the plant. The marine biological fouling is found growing throughout the structure, on the sluice gates and all around the concrete walls. We are proposing to develop a system using ultrasonic technology since it has already been proven to work in similar applications such as the boating industry. The proposed solution is to design an ultrasonic system that will be embedded on to the structure, emitting ultrasonic waves that will resonate throughout the structure. These sound waves will eliminate single cell organisms, removing the initial link in the marine food chain. As to who will benefit from the system we have a large number of industrial facilities using these intakes, oil and gas refineries, power plants and desalination plants.

## **CAEE-20 NET ZERO ENERGY WASTEWATER TREATMENT PLANT**

**Advisor:**      *Dr. Charles Haas*

Team:

Luke Campbell	Civil Engineering
Kinman Leung	Environmental Engineering
Nahjan Amer Nordin	Environmental Engineering
James Pagel	Environmental Engineering

The objective of the project was to create a net zero energy wastewater treatment plant for the client, Philadelphia Water Department, as part of the city's steps towards more sustainable integrated urban water systems. The two main challenges tackled were the following: one, to identify suitable technologies, existing and new, to meet project goal and two, to recover energy while still ensuring that final effluents were within limits. Based on literature review and quantitative analysis performed on alternatives evaluated, the final specifications were wastewater treatment plant using upflow anaerobic sludge blanket as the primary biological treatment process and biogas in the form of methane as the main source of energy production. The gas is to be captured and delivered to a cogeneration facility for electricity generation. Other design factors such as sizing of the tanks, secondary clarifiers, disinfection and more were also considered and accounted in the final specifications.

## **CAEE-21 CYNWYD STATION WATER MANAGEMENT SYSTEMS**

**Advisor:**      *Dr. Shi-Chieh Cheng*

Team:

Loren Aloï	Civil Engineering
James Driscoll	Civil Engineering
Evan Rosario	Civil Engineering
Benjamin Wilk	Civil Engineering

The Cynwyd Station is a key historical landmark in the region and the head of the Cynwyd Heritage trail. Group 21 was asked by the Lower Merion Historical Society to design improvements to mitigate runoff problems on site. The stormwater mitigation designs considered in the design process recognize the goal of transforming the station into a green community center.

The solutions designed were a stormwater disposal system for roof runoff through groundwater recharge; a system to mitigate the erosion problems in the existing drainage swale and new gabion retaining wall; a system to dispose of runoff generated by the slope of Conshohocken State Road; and an environmental impact analysis and mitigation plan for the station. The goal of the environmental impact analysis was to offset station energy consumption through various upgrades. A carbon footprint analysis was performed on the station and any upgrades, with analysis performed using the life cycle assessment program "SimaPro".



**CAEE-22**  
**VENICE ISLAND RESTORATION, MANAYUNK, PA**

**Advisor:**      *Dr. Joseph Martin*

Team:

Andrew Burkard	Architectural Engineering
Josh Highfield	Civil Engineering
Johan Kvist	Architectural Engineering

Venice Island is located in the Manayunk neighborhood of Philadelphia, PA between the Schuylkill River and the Manayunk Canal. The Island has long been an eyesore for the residents of the city due to the remnants of a burned-down mill. Therefore a strong desire to renovate the island exists. Recent events have left the property stagnant as court decisions have found proposed designs have not adequately accounted for site flooding and the danger to public and property. After careful consideration of different options and design issues, the design team moved forward with new a raised-storey residential building to be integrated into the site. Design has been performed of the necessary site and building systems for the proposed lot, with heavy weight being placed on environmental and economic criteria. The sites location in the flood fringe has impacted all design systems, emphasizing a need to reduce damage and account for loading.

**CAEE-23**  
**RUNWAY EXPANSION PROJECT AT FORT LAUDERDALE-HOLLYWOOD INTERNATIONAL AIRPORT (FLL)**

**Advisor:**      *Dr. Joseph Martin, Dr. Anu Pradhan*

Team:

Nick Deviso	Civil Engineering
Mark Drosnock	Architectural Engineering
Shady Elshetwy	Civil Engineering/Architectural Engineering
Javier Hendricks	Civil Engineering/Architectural Engineering
Tom Zabriskie	Civil Engineering

Fort Lauderdale-Hollywood International Airport (FLL) experiences a rise in air traffic which creates high levels of congestion for the passengers as well as the cargo airlines such as UPS and FedEx. The airport can only take off and land a single aircraft at a time. This single landing, take off procedure adds to the growing congestion. In order to solve the issue, the team created a series of alternative solutions to resolve the growing demand. The team finally decided to build a second runway parallel to runway 13-31. This would not only allow for dual movement operations but will open up space for a new apron for additional terminals. This opens up the airport for future growth as well as room for new clients. The solution is also contained within the airport's existing property so no additional acquisitions will be required.

## **CAEE-24**

### **THE DESIGN AND DEVELOPMENT OF A MIXED-USE ARENA ON A RECLAIMED LANDFILL SITE**

**Advisor:**      *Prof. Robert Brehm*

Team:

Nawaf Droubi	Civil Engineering
Gavriel Gefen	Civil Engineering
Margarita Pauliushchyk	Architectural Engineering
Justin Smith	Civil Engineering

The purpose of this project is the design and development of a mixed-use sports arena on a reclaimed landfill site in Bellmawr New Jersey. The maximum seating capacity of the arena is 11,000 and can accommodate many different events such as hockey, basketball, and concerts. Some of the challenges facing this project include the difficulties that come with building on a reclaimed site as well as structural design, foundation design, storm water management, parking lot space and the egress in and out of the site. The arena itself will be built on a mat foundation to avoid penetrating any clay caps in the landfill and to limit differential settlement. In case of storms and runoff water overflow a dry detention basin has also been constructed outside the site near the creek. The project is located in a prime location just outside of Philadelphia with access from route 42 and interstate 95.

## **CAEE-25**

### **DREXEL UNIVERSITY'S HAGERTY LIBRARY REDESIGN**

**Advisor:**      *Dr. Yared Shifferaw*

Team:

Kesla Duka	Civil Engineering
Owanari Iyalla	Civil Engineering
Daniel James	Architectural Engineering
Oleg Shum	Civil Engineering
Chihiro Watanabe	Architectural Engineering

Drexel University's Hagerty Library has been having difficulties in accommodating the current student load. The buildings infrastructures, such as the structural, HVAC and Electrical system were also advancing in age. With increasing student demands on the library and the need for more sustainable building designs, something had to be done with the library. The proposed solution by our team was to construct a new library building focusing on increasing the amount of space for students as well as keeping Drexel's high standards for technology. The structural system design was redone using steel to optimize sustainability and maximize the spatial efficiency. A new energy efficient HVAC system was implemented with detailed architectural design to minimize energy use in the facility. Finally, the power system was designed to better fit the student needs with receptacles throughout the building so that students can better utilize their own technology for learning.

## **CAEE-26**

### **STORM WATER RUNOFF RETENTION SYSTEM FOR OLDER AREAS OF PHILADELPHIA**

**Advisor:**      *Dr. Mira Olson*

Team:

Kwabena Atakora-Owusu	Environmental Engineering
Nick Cook	Civil Engineering
Glen Hunter	Architectural Engineering
Jaiva Williams	Architectural Engineering

Storm water runoff has become an increasing problem in Philadelphia as displayed by flooding basements and large pond-like puddles around the city. The purpose of this project was to develop a way to reduce storm water runoff on a typical Philadelphia street. Philadelphia streets are typically narrow with street parking and slim sidewalks. Without the removal of residential parking, typical storm water reduction plans such as tree pits, and curb bump outs are difficult to implement. This project examined the feasibility of placing water storage tanks beneath a city street to reduce storm water runoff. The water would enter the tanks through storm grates and be stored while it infiltrates into the surrounding soil. By placing these tanks beneath the street, residential parking and sidewalk space were not reduced and storm water was reduced by 3.6 cubic feet per second.

## **CAEE-27**

### **WARMINSTER SOCCER COMPLEX AND WREC**

**Advisor:**      *Dr. J. Richard Weggel*

Team:

Cory Christian	Civil Engineering
Ryan Dolin	Civil Engineering
Ben Durey	Civil Engineering
Ryan Krall	Civil Engineering

The township of Warminster is in need of a new youth soccer complex and a replacement to their current recreation and education center (WREC). The youth soccer complex that has been designed includes a single, championship style, artificial turf field along with additional natural turf playing fields. The new WREC center will be built on the same site as the soccer complex and will include offices, education/group exercise rooms, storage and an indoor basketball court. The location of these projects is a retired naval air warfare center that was donated to Warminster for use as a community park. Warminster will receive funding from multiple grants for construction of the soccer fields allowing for budget to not be a large deciding factor. The WREC had a set budget of \$2.2 million which needed to include all aspects of the building, including landscaping and decorative features.

**CAEE-28  
REDEVELOPMENT OF DREXEL UNIVERSITY'S "F" LOT**

**Advisor:**      *Dr. Joseph Martin*

Team:

Tyler J. Barile	Civil Engineering
John C. Medendorp IV	Civil Engineering
John Petrongolo	Civil Engineering/Architectural Engineering
Jaclyn Raciti	Civil Engineering
Matthew Tedesco	Architectural Engineering

The purpose of this project was to respond to a "request for proposal" set forth by Academic Properties, Inc., for the redevelopment of Drexel University's F Lot. From the three designs considered, the alternative chosen encompasses a subterranean parking garage, a public and private recreation area, and a residential complex. A parking garage layout, building floor plans, unit layouts, preliminary column spacing, layouts of recreation areas, and preliminary site grading was then completed. Designs for the structures and recreational areas were then finalized and structural analysis was completed for the project. Stormwater analysis was also used to calculate site runoff. Building operational costs were estimated and utilized to perform an economic analysis. These results were used to weigh the pros and cons of incorporating passive building technologies. Over the course of the project, design and construction budgets were also created and maintained.

**CAEE-29  
DREXEL PARK REVITALIZATION**

**Advisor:**      *Dr. Peter DeCarlo*

Team:

Brian Hindes	Architectural Engineering
Michael Leone	Civil Engineering
Luke Rider	Architectural Engineering
Charles Zebley	Civil Engineering

Drexel Park is a 2.5 acre lot on the east side of 32nd street between Powelton Avenue and Baring Streets. To alleviate the parking congestion created by off campus students and faculty commuting, we are proposing the construction of a "green" parking garage underneath the park. The use of concrete admixtures will allow the garage itself to absorb and breakdown the harmful pollutants that come from vehicular exhaust. The use of light wells and tunnels will allow the garage to be lit using as much sunlight as possible and minimize the need for artificial lighting. The park above will also be renovated in order to beautify the park. The design will follow the green initiatives of Drexel University and the City of Philadelphia. Our design calls for large NEXT double-tee beams for the roof structure. These members are supported by interior walls and exterior, dual-purpose retaining walls.

**CAEE-30  
REPAIR & RETROFIT OF THE WEST RIVER DRIVE BRIDGE**

**Advisor:**      *Dr. Franklin Moon*

Team:

Michael Andrews	Civil Engineering
Jesse Buck	Civil Engineering
Bill Gonnely	Civil Engineering
Jordan Madeja	Civil Engineering

We have adopted the West River Drive Bridge from the City Of Philadelphia to diagnose its current conditions, and make recommendations on how to repair and retrofit the bridge. Through detailed photo documentation and creation of a thorough inspection report, we identified the main areas of concern that pose threats to bridge's durability. Multiple hazards were assessed including flooding, fatigue and the possibility of fracture critical failure. Flooding has already been shown to be a more recent threat than in the past. An AutoCAD Model of the bridge was imported into SAP2000 to analyze the bridge for fatigue and test if the bridge is truly fracture critical. Once all our analysis was completed, we presented our findings to the City Of Philadelphia and made our recommendations as for the best course of action to take.

**CAEE-31  
WEST PHILADELPHIA HIGH LINE AREA DEVELOPMENT**

**Advisor:**      *Dr. Ivan Bartoli*

Team:

Robert Cornell	Civil Engineering
Richard Hall	Architectural Engineering
Nicholas Romano	Architectural Engineering
Sonya Suntsova	Civil Engineering
Taylor Wright	Architectural Engineering

The West Philadelphia Elevated High Line runs through Drexel University's campus and allows for the delivery of freight throughout the South Eastern region of Pennsylvania and beyond. Due to the high line's importance, it cannot be removed, but it is evident that it has become a source of noise pollution and an unattractive entrance to Drexel University. It has become increasingly evident that the amount of space available for students in the CAEE department is very low. In order to combat these problems a plan has been developed to create an Engineering Student Center which will surround the high line. The high line will be retrofitted to address servicability concerns. These solutions will help to improve the overall appearance of Drexel University's campus in accordance with the master plan as well as reduce noise pollution caused by the use of the high line by CSX and other freight companies.

**CAEE-32**  
**DREXEL UNIVERSITY HOTEL AND CONFERENCE CENTER**

**Advisor:**      *Prof. James E. Mitchell*

Team:

Derek Bensinger	Architectural Engineering
Michael Eversole	Architectural Engineering
Seth Krause	Architectural Engineering
Samantha Sukonick	Architectural Engineering

Drexel is an establishment that is constantly striving for improvement. The problem being addressed is Drexel's lack of appropriate space to accommodate professional events and families' visiting Drexel. Lotus Designs and Solutions LLC, has proposed to design a Hotel that incorporates luxury suites, business meeting rooms, and large event spaces.

The building was designed to adhere to the program and needs of Drexel University, while also remaining aesthetically pleasing. The design incorporates three structures; Hotel, Conference Center, and Parking Garage. Our team has solely focused on the Hotel. There are basic designs of both the Conference Center and Parking Garage. Each system has been designed for the Hotel including; architectural, structural, HVAC, electrical, plumbing, site and civil, foundations, and LEED certification. The vehicular and pedestrian flow of traffic has also been considered and worked into the total design to ensure safety and convenience for our future guests.

**CAEE-33**  
**DESIGN OF A NET-ZERO WATER FOOTPRINT BUILDING**

**Advisor:**      *Dr. Charles Haas*

Team:

Brent Heverly	Environmental Engineering
Stephanie Kasprzak	Environmental Engineering
Anna Schmiedicke	Environmental Engineering
Michael Wilks	Environmental Engineering

Urban high occupancy buildings have added to the increasing stress on water systems through high potable water demand, immense wastewater discharge, and contribution to runoff management issues due to impervious land surfaces. As water sources are strained by overuse and pollution, potable water prices have greatly increased in the last few years, leading to a more holistic look at how water systems can be made more efficient. The design team investigated options to retrofit building water systems to optimize water use and minimize wastewater discharges and stormwater runoff. They chose to test a strategy to create net-zero water footprint buildings: building water systems that have no municipal water intake and no wastewater discharge. Rainwater would be treated in a package treatment system to potable water standards, and water drained from fixtures would be treated to graywater standards for toilet fixtures. Drexel University's Nesbitt Hall was selected as the pilot study location for such a net-zero water footprint building.

## **CAEE-34**

### **DISSECTING THE STRUCTURAL DESIGN PROCESS THROUGH THE DESIGN OF A SCALED MODEL OF A STEEL BRIDGE AND CORRELATING WITH ITS PROTOTYPE**

**Advisor:**      *Dr. A. Emin Aktan*

Team:

Abdulaziz Al-Sulaiti	Civil Engineering
Ghanim Al-Sulaiti	Civil Engineering
Christopher Colyer	Civil Engineering
Xiufeng Chen	Civil Engineering

Drexel University Steel Bridge Team has been challenged to participate in the student steel bridge competition of 2013. This includes designing, fabrication, and construction of a scaled model of the steel bridge. The students applied their engineering skills, principles, and co-op experience to get the maximum benefit in fabricating the entire steel bridge model. Also, the students gained practical experience in construction planning and project management areas.

The team researched the history of steel bridges and different structural forms that can be used in the design process that fits the problem statements requirements.

The team participated in design, small-scale model testing, full-scale component testing, fabrication, construction, and testing/loading of the full-scale bridge. The team used various resources to attain knowledge of the steel bridge competition by reviewing the problem statement requirements, current rules, design space specifications, project's hard and soft constraints.

*Sponsors: Boeing, Kiewit, High Steel*

## **CAEE-35**

### **MODULAR HOUSING COMPLEX FOR HABITAT FOR HUMANITY PHILADELPHIA**

**Advisor:**      *Dr. Aspaisa Zerva, Prof. Robert Brehm*

Team:

Cheau-Erl Lam	Architectural Engineering
Rebecca Reyman	Civil Engineering
Evan Richter	Architectural Engineering
Matthew Zimmer	Civil Engineering

Habitat for Humanity Philadelphia provides housing to low income residents, allowing applicants to earn home ownership by volunteering time in place of interest. However, Habitat can only accept applicants if a sufficient amount of volunteer work is available. Lack of construction is a factor of the limited funds and land Habitat has available. With the limited homes being built, Habitat often has to turn away qualified applicants. These problems can be addressed with a more efficient building method that not only streamlines the building process, but costs less than typical site builds. Modular construction, the method of prefabrication sections and then assembling on site, in Philadelphia take half the time, as the construction and foundation work are done simultaneously, and costs 20 percent less than typical stick builds. In this report, we will design a modular housing complex on the site provided at 19th and Montgomery Ave.

**CAEE-36**  
**RAIL TO RETAIL - A SUBWAY REPURPOSING**

**Advisor:**      *Prof. James E. Mitchell*

Team:

Ece Koch	Civil Engineering
Greg Potens	Civil Engineering/Architectural Engineering
Michael Sohanic	Architectural Engineering
Dan Taylor	Civil Engineering/Architectural Engineering

The group has renovated and repurposed the Pennsylvania Avenue Subway tunnel, which supports Pennsylvania Avenue in the Fairmount section of Philadelphia, into a walking strip mall. The tunnel is a sub-grade, brick arch tunnel built in 1897. The tunnel served the industrial centers of Philadelphia and is 52 feet wide, 3000 feet long, and 22 feet high. The mall will run from the Philadelphia Museum of Art underground to a plaza opening located at the Rodin Museum at 21st and Hamilton. The plaza area, which is sub-grade but open to the above, has been repurposed into a cafe and stage. The group has implemented 20 retail shops in the tunnel totaling 31,350 square feet of retail space. The total development area in the tunnel and plaza is approximately 150,000 square feet. The group has performed all of the major engineering for the structural, mechanical, plumbing, fire protection, traffic control, and electrical systems, as well as the architectural needs.

**CAEE-37**  
**RENOVATION AND EXPANSION OF TOWERS HALL DORMITORY**

**Advisor:**      *Dr. Franklin Moon*

Team:

John Braley	Architectural Engineering
Angelo Faia	Civil Engineering
Christine Kerner	Architectural Engineering
Douglas Wentzel	Civil Engineering

BFKW Engineers have proposed a complete renovation and expansion of the Towers Hall Dormitory on the corner of 34th and Arch Streets. To fulfill the growing need for student housing, this renovation and expansion will generate roughly 600 additional beds to Drexel's campus. The project will focus on the structural, mechanical and geotechnical aspects of the building, utilizing sustainable features that will conform to the strategic master plan, as outlined by the university. Through the use of 3D modeling software, the structural and mechanical designs of the existing and proposed addition will be analyzed and optimized to achieve the most efficient design. The structural design includes existing and proposed structure compatibility analysis; while the mechanical components evaluate cost effectiveness of the latest sustainably features that address energy consumption. Geotechnical will focus on extensive site work solutions, from foundations to storm water management.



**CAEE-39**

**TRAFFIC CONGESTION IN NORTHEAST PHILADELPHIA: A TRAFFIC STUDY OF BYBERRY ROAD**

**Advisor:     *Dr. Joseph Martin***

Team:

Nicholas Calvanese	Civil Engineering
Ira Fedder	Civil Engineering
Anthony Spinozzi	Civil Engineering
Tyson Thomas	Civil Engineering

The Byberry congestion relief plan is an update to the existing Woodhaven Road Traffic study performed by the Delaware Valley Regional Planning commission in 2002. The team researched the problem to identify critical infrastructure and use patterns on Byberry Road where it connects the neighborhoods of Somerton and Bustleton to Woodhaven Road. The team analyzed current and projected daily demand for this corridor and identified local factors causing congestion in the area. Using this information the team searched for viable, low impact solutions that could be implemented here. The team assembled a list of solution alternatives, compared them on various measures of effectiveness, and chose the best solutions for continued analysis. The team has defined a demand relief solution, a capacity increase solution, and an accessibility solution for this corridor. The team took each solution to complete design and will use design results for submission of the final recommendation.

## **CBE-01 TERRAFORMING MARS**

**Advisors:**     *Dr. Gennaro Maffia*

Team:

Nicole Fusco	Chemical Engineering
William Houlihan	Chemical Engineering
Patrick Kritiz	Chemical Engineering
Leah Spangler	Chemical Engineering

Earth's increasing population combined with unsustainable use of its resources has resulted in the need for the development of more radical solutions for future generations. Among these potential solutions exists the possibility of terraforming Mars to create an additional livable planet. One method would use the Sabatier reaction to produce methane, a potent greenhouse gas, from carbon dioxide and water, which are naturally available on Mars. Increasing the atmospheric concentration of methane to 300 ppm would cause the temperature of the planet to increase. This increase would result in a runaway greenhouse effect by melting the polar ice caps and liberating large amounts of carbon dioxide trapped within them. Due to the extensive scope and cost of the project, a pilot scale plant was developed to operate on Mars producing 12,500 tons of methane per year. Capital costs including equipment, construction and transportation to Mars are estimated to be \$300 billion.

## **CBE-02 TERRAFORMING MARS TERRAFORMING MARS**

**Advisors:**     *Prof. John Speidel, Dr. Christopher Peters*

Team:

Marissa Gregoroy	Chemical Engineering
Christopher Hill	Chemical Engineering
Catlin McRae	Chemical Engineering
Brian Reilly	Chemical Engineering

Over 14% of the world's electricity comes from nuclear reactors powered by uranium, which translates to 2,500 billion kWh/yr [2]. The currently known reserves of uranium are expected to last only 20 years at current use rates and seawater uranium will likely be a very important source [1]. Team On A Rowell has designed a plant for taking uranium from seawater in amidoxime sponges and producing UO<sub>2</sub> for use in nuclear reactors. The sponges are placed on a conveyor belt and sprayed with nitric acid to remove the uranyl ion complex. This uranium in the form of uranyl nitrate hexahydrate is then reacted to form UO<sub>3</sub>, which is reduced with hydrogen to form UO<sub>2</sub>. The sponge is then recycled using potassium hydroxide for reuse. It is crucial to consider the safety, environmental impact, and sustainability of the system, as the chemicals in the plant range from 67% nitric acid to the neurotoxic UO<sub>3</sub>. There will therefore, be several active and passive safety features to mitigate possible dangerous situations within the process. Overall, the plant operates 8,256 hours per year and has a capacity of 701,760 lbs/yr. The plant has an expected time of 50 years. In the economic analysis, the plant was deemed to be profitable with a discounted cash flow rate of return of 60.11% and a payback period of 1.3 years.

### **CBE-03**

#### **ETHYLENE PRODUCTION THROUGH CATALYTIC CRACKING**

**Advisor:**      *Prof. Gennaro Maffia*

Team:

Anqi Feng	Chemical Engineering
Colleen Guyre	Chemical Engineering
Joy Kalemera	Chemical Engineering
Raj Patel	Chemical Engineering

Ethylene is one of the main components for the producing of plastics and fertilizers.

The location of the grass roots plant will be near Monaca in Beaver County, PA, USA, based primarily on the proximity of the natural gas liquid (NGL) pipeline. It would be Pennsylvania's first ethane cracking plant and would be owned by Shell Corporation. The ethylene would be in the form of a refrigerated liquid. The plant will be close to the Ohio River, which will help in the transportation of big reactors to the site.

The process is going to use oxidative dehydrogenation, which has only been done on bench scale. The amount of ethylene produced at the plant could be as much as 907,000 metric tons per year, however due to lack of optimization the current production rate is 655,000 metric tons per year. In the plant, approximately 100 people would be working on site in the inner and outer boundary limits.

### **CBE-04**

#### **ISOMERIZATION OF PENTANE TO MAKE ISOPENTENE**

**Advisor:**      *Mr. David Kolesar*

Team:

Yaroslav Dankulich	Chemical Engineering
Tanzin Fatima	Chemical Engineering
Arpit Patel	Chemical Engineering

The project "Isomerization of Pentane to make iso-pentene" is an addition to the existing refinery done by AYT LLC consulting company. The purpose of this design project is to isomerize pentane in order to make iso-pentane (which is widely used to improve the octane number in gasoline) in a cost effective way. Based on the favorable weather conditions, availabilities of the utilities needed to operate the plant, lower costs, the plant is to be set in West Texas.

This process involves a reversible reaction, which converts n-pentane to isopentane. The reactor is operated at a pressure of 350 F and achieves a 70% conversion. According to the material balance, mass flow rates of inlet and outlet are 111376.3 and 81482.46 kg/hr, respectively. Total energy intensity of the system is 519186.9 MJ/hr. The discounted cash flow rate of return (DCFROR) is calculated and found to be 17.82%. The total equipment cost, fixed capital cost, the annual utility cost, total raw material cost, product cost, manufacturing cost are estimated to be \$ 60,312,200, \$89,200,000, \$65,000,000, \$856,776,148, \$1,221,248,206, and \$1,153,029,039 respectively. The revenue after selling the product is \$1,221,248,206 assuming 21 turnover days per year. Based on the economic and market analysis, it is concluded that the product of this project (premium gasoline) is not only profitable economically, but also it will fulfill the future demand of gasoline in the United States.

## **CBE-05**

### **NON THERMAL RECOVERY OF METALS FROM ELECTRONIC WASTE**

**Advisor:**      *Mr. Steven Schon, Arkema Inc.*

**Team:**

Colton Bower	Chemical Engineering
Daniel Davis	Chemical Engineering
Jahnvi Deshmukh	Chemical Engineering
Anirban Ghosh	Chemical Engineering

Team “Winning Gold” proposes an industrially feasible process for the non-thermal recovery of metals from electronic waste, primarily comprised of printed circuit boards (PCBs). The design is a batch scheme that incorporates sequential leaching through the use of methane sulfonic acid, sulfuric acid, and ammonium thiosulfate as lixivants, followed by electrowinning processes to electroplate leached metals (Au, Ag, Pt, Pd, Cu, Pb). The plant has six identical process trains and can handle 30 MM lbs of e-waste annually. Evaluation of equipment costs and capital investment suggests an estimated plant capital cost of \$108 MM. Over the planned 15 year plant life, assuming a 12% discount rate, the projected IRR is 63.4%, the NPV is \$620 MM and the payback period is 2.3 years. Therefore an energy efficient, safe and environmentally sustainable process methodology has been proposed which offers an attractive alternative to currently existent, thermally intensive pyrometallurgical metal recovery processes.

## **CBE-06**

### **EFFICIENCY IN THE BREWING INDUSTRY**

**Advisor:**      *Mr. Michael Keane*

**Team:**

Dan Feerst	Chemical Engineering
John Latwinas	Chemical Engineering
Aleece Phillips	Chemical Engineering
Tom Sipe	Chemical Engineering

The Capstone Project, “More Efficient Production of Beer” looked at energy and cost savings measures that will reduce energy consumption, costs, and environmental emissions. Project life is estimated at 100 years. By conducting a financial analysis of the system, the discounted cash flow rate of return (DCFROR) was estimated to be 121.8%. Based on these numbers, and the analysis of different process models, it is recommended that the most efficient way to produce beer is to have a process which includes an anaerobic digester, activated carbon adsorption, and pressure swing adsorption. This results in a water to beer ratio of 1.64 barrels of water used per 1 barrel of beer consumed.

Research was initially done by conducting a tour of the Anheuser-Busch brewery in Newark, NJ. This plant serves as a model for the system described in this report, as the location and the use of an anaerobic digester is the same. The brewery in Newark has a capacity of producing nine million barrels of beer per year with about a dozen different brands produced there. The system in this report is much smaller scale, only producing one million barrels of beer per year and only producing one kind of beer. This was done to simplify calculations. Research was then conducted on new technologies with an emphasis on reusing any byproduct of the brewing process.

## **CBE-07**

### **SATELLITE HYDROGEN PEROXIDE PRODUCTION FACILITY FOR PAPER MILLS**

**Advisor:**      *Mr. Steven Schoen*

Team:

Chijioke Anyibo	Chemical Engineering
Thomas Bahls	Chemical Engineering
Michael Troyanoski	Chemical Engineering
Timothy Easham	Chemical Engineering

The following proposal is a design to produce hydrogen peroxide, H<sub>2</sub>O<sub>2</sub>, on site through direct synthesis, for a paper mill's pulp bleaching process. This plant is specifically designed to meet the needs of International Paper's production facility in Erie, Pennsylvania.

This project will only have to meet the demand of one paper mill. This small scale makes it advantageous to use a direct synthesis combining O<sub>2</sub> and H<sub>2</sub> directly, by way of a Palladium catalyst. The plant's full production capacity will be 300 lb/hr of pure H<sub>2</sub>O<sub>2</sub>, already diluted to 4.0% for use by International Paper. The plant will be operating at 240 lb/hr of pure H<sub>2</sub>O<sub>2</sub>. There is no risk of toxic releases. International Paper will be saving \$0.53 per pound utilizing the onsite production method which equates to \$1.7MM/yr.

The estimated capital cost for this project is \$14MM. International Paper will see a cost benefit due to the absence of purification, transportation and dilution. The internal rate of return is (IRR) is 16% upon the initial investment. The payback period is 7.94 years and the net present value (NPV) of the project is \$3.75 M.

## **CBE-09**

### **PROPYLENE OXIDE SYNTHESIS FROM HYDROGEN PEROXIDE AND PROPYLENE: HPPO PROCESS**

**Advisor:**      *Dr. George Rowell*

Team:

Sneh Bhatt	Chemical Engineering
Bill Iamurri	Chemical Engineering
Ian Vaughan	Chemical Engineering
Ian Wilson	Chemical Engineering

The following proposal is a design to produce Propylene Oxide (PPO) from Propylene (PO) and Hydrogen Peroxide in an integrated plant.

Propylene oxide is synthesized from propylene and hydrogen peroxide in one main reaction. The purification process requires 3 flash drums, 5 step distillation and a reactor and allows for the recycling of expensive raw products such as Methanol and propylene. A by-product of the reaction are excess oxygen, water, and propylene glycol. The plant capacity is 300,000 metric tonnes of propylene oxide annually. The estimated capital investment cost is \$70 MM. The discounted cash flow rate of return (DCFRR) is 20 percent over life of the plant.

## **CBE-10 ACETIC ACID PRODUCTION FROM NATURAL GAS**

**Advisor:**     *Dr. Richard Cairncross*

Team:

Christopher Curran	Chemical Engineering
Christina Deetscreek	Chemical Engineering
Wesley Hare	Chemical Engineering
Phuong Tran	Chemical Engineering

This project examines the feasibility of an acetic acid plant that converts purified natural gas to 99.9% pure acetic acid. The plant size, which is designed to produce 525,800 tonnes per year, is based on other acetic acid production plants utilizing the Cativa technology. The Cativa method is a patented process that allows for the production of large quantities of high purity acetic acid, with few byproducts. The location of the plant site is New Castle, PA. This site utilizes natural gas sourced from Marcellus Shale, a region where the production of natural gas is among the highest in the United States. Based on this feasibility study, the fixed capital required to build the proposed plant is \$132,200,000. In addition, the Discounted Cash Flow Rate of Return is 48.5% and payback period is 1.43 years. The proposed plant design is both feasible and profitable.

## **CBE-11 DIMETHYL ETHER SYNTHESIS THROUGH BLACK LIQUOR GASIFICATION**

**Advisor:**     *Dr. Michael Grady, DuPont*

Team:

Chemazu Amadi	Chemical Engineering
Ryan Bortner	Chemical Engineering
Jia Ying Xu	Chemical Engineering

The focus of this project was the design of an add-on gasification plant that will convert black liquor to dimethyl ether (DME). Using research from the pilot plant owned by Chremec a 3000 tonnes/ day black liquor plant was designed. This allows for production of roughly 792 tonnes/day of DME. Black liquor input was an average production ratio of world yield. A single step DME synthesis was selected for higher conversion when compared to the normal two step process. It also allows for a 1:1 ratio of CO to H<sub>2</sub> which is the composition from the gasifier. The bare module cost of the project is estimated to be around \$316 MM. The annual cost of manufacturing is \$192 MM; this includes raw material, operating and utility costs. Revenue from produced DME is estimated at \$279 MM allowing for a profit of \$87 MM each year after payback is achieved.

## **CBE-12**

### **SYNTHESIS OF HEPTALDEHYDE AND UNDECYLENIC ACID FROM CASTOR OIL**

***Advisor: Mr. Michael Kain***

Team:

Hardik Patel	Chemical Engineering
HyunKyun Ro	Chemical Engineering
Laura Wehmeyer	Chemical Engineering
Rebekah Williams	Chemical Engineering

Heptaldehyde and undecylenic acid are castor oil derivatives utilized in products such as adhesives, plasticizers, flavors, and fragrances. Castor oil is obtained from the seeds of the *Ricinus communis* plant. This castor oil producing plant is generally grown in tropical climates, and is mainly exported from India and Brazil. CastorWay Chemical Company desires to construct a plant in Argentina to produce 1.7 MM pounds of heptaldehyde and 2.3 MM pounds of undecylenic acid per year for use in the flavor and fragrance industry. This is accomplished via the methanolysis of ricinoleic acid in castor oil to produce methyl ricinoleate, the pyrolysis of methyl ricinoleate to produce heptaldehyde and methyl undecylenate, and finally the hydrolysis of methyl undecylenate to produce undecylenic acid. The goal is to design the plant to minimize safety and environmental hazards while maximizing production rate. The innovative processes designed by CastorWay Chemical Company result in a plant with a discounted cash flow rate of return of 22%.

**CS-01**  
**IMAGINE CUP**

**Advisor:**      *Prof. Frank Lee*

Team:  
Leo Levitt                                      Computer Science  
Kent Pasquino                                 Computer Science  
Joleen Petroski                                Computer Science

Many times, games simply slap an extra coat of paint of mathematics or language skills onto a simple game and pass it off as educational. But this approach doesn't fully utilize the abilities that video games have in teaching the player mechanics as the player progresses through a game. The Excavist solves this problem by employing a simple interface for young users to play a game while simultaneously learning skills that are a major part of the Common Core Curriculum. Focusing on combining learning with simple interactions, the player will be able to not only learn how the game itself functions, but also learn valuable math skills, including the addition and subtraction of fractions, division, and finding the Greatest Common Denominator, in the process. The game encourages critical thinking in a time-based environment, allowing for development of math skills to occur over time against different levels of difficulty.

**CS-02**  
**POS CONNECT**

**Advisor:**      *Prof. Jeff Salvage*

Team:  
Martin Barbella                                Computer Science  
Ryan Christen                                 Computer Science  
Sidhant Garg                                    Computer Science  
Taite Hughes                                    Computer Science  
Mahamadou Kone                               Computer Science  
Pradit Modi                                      Computer Science

One problem with existing e-commerce applications such as Magento and Shopify, is the difficult task of integrating with Point-Of-Sale (POS) databases. This forces users to seek professional assistance to set-up their web-stores, often times straining their businesses financially. The goal of POS Connect is to aid local businesses in obtaining an online presence. POS Connect enables inexperienced users to setup, use, and modify an online web-store, giving small business owners a simple interface through which to integrate a web-store with Point-Of-Sale at an affordable price. This can be accomplished by implementing a web application and desktop service with a registration feature, further facilitating the web-store development process.



### **CS-03**

#### **GardenWithMe Or HELLO GARDEN!**

**Advisor:**      *Prof. Jeff Salvage*

Team:

Matthew Campbell	Computer Science
Scott Hooper	Computer Science
Quoc Le	Computer Science
Aaron Pagano	Computer Science
Thomas Rottinger	Computer Science
James Schulze	Computer Science
Zachary Tahenakos	Computer Science

Harvest Helper is the intersection between the computer world and the real world. This project gives gardeners the ability to remotely analyze their garden and view information about their garden. Harvest Helper is made primarily from an in-ground garden device, a server, and a website.

The in-ground garden device, encased in a custom enclosure, makes use of a Raspberry Pi, an Arduino, and environmental sensors that read data such as temperature and soil humidity from the environment around it. This data is then sent (via a wired or wireless connection) to a server. Users can then view their data and receive notifications about their garden through a website. Additionally, users can use the website to schedule how frequently data is collected from their garden and interact with other users via a discussion forum

### **CS-04**

#### **WhatUp**

**Advisor:**      *Dr. Jeffrey Popyack*

Team:

Noah Black	Computer Science
John Brodie	Computer Science
Lakshit Dhanda	Computer Science
Anthony Hurst	Computer Science
Damali Martin	Computer Science
Ayush Sobti	Computer Science

WhatUp is a communication tool built for cross-functional, autonomous development teams. It allows for the sharing of ideas, decisions, articles, and more. Following the UNIX philosophy, WhatUp is a small, focused platform where content is king. With a tagging system and publisher-subscriber model, WhatUp provides a platform with very little setup required, and gives users only the information that they request. All of WhatUp's functionality will be accessible via a website, and will also be provided to other tools with a RESTful API. WhatUp is the best parts of email, Twitter, WordPress, and wiki, with setup requiring only one click.

## **CS-05 COURSE SCHEDULER**

**Advisor:**      *Dr. Dario Salvucci*

Team:

Rob Brown	Computer Science
Nate Fonseca	Computer Science
Max Haley	Computer Science
Mike Kovalchik	Computer Science
Joe Nelson	Computer Science
Basil Nyachogo	Computer Science
Ray Selfridge	Computer Science

Docket is a decision support system that allows University administrators to effectively manage departmental resources, resolve scheduling conflicts, and reduce cost associated with scheduling academic courses. Docket's primary goal is to identify scheduling conflicts and notify users in order to facilitate conflict resolution.

## **CS-06 iORTHO+**

**Advisor:**      *Dr. Santiago Ontañón*

Team:

Austin Blakeslee	Computer Science
Steven Hansen	Computer Science
Steven Hershey	Computer Science
Matt Hinkle	Computer Science
Dylan Kenny	Computer Science
Alexy Thomas	Computer Science

iOrtho+ is your mobile guide for orthopedic information. This application was designed two years ago for rehabilitation professionals, educators, and clinicians by Therapeutic Articulations, LLC. iOrtho+ is a mobile and comprehensive reference for orthopedic Special Tests and joint Mobilization Techniques developed from advanced, evidence-based knowledge and extensive clinical practice.

Scope of the project includes enhancing the architecture to improve the maintainability and usability of the application. Through the use of Amazon's S3 cloud service, the team intends to migrate all data to an external source, thereby allowing an administrator to edit content remotely, enabling a more seamless user experience for customers and educators. The team works in a cross-platform environment, utilizing prior academic and professional experience, to not only create an administrator-interface program, but also enhance the current mobile applications' feature-set. Therapeutic Articulations will no longer need to release new editions of the applications upon content updates, saving weeks of lag-time from the publishing process.

**CS-07**  
**SPARC**

**Advisor:**      *Dr. Yuan Fang Cai*

Team:

Wei-Tin Chang	Computer Science
Anthony Dagostino	Computer Science
Matthew Grossman	Computer Science
Aradhya Malhotra	Computer Science
Stephen Siu	Computer Science

The current power grid only allows for the simple task of power transmission from power producers to power consumers and is not 'Smart'. The producers cannot actively notify the consumers of their power usage patterns nor provide them with incentives to save power which would result in financial savings and environmental benefits. Additionally, in the case of an emergency situation resulting in a power shortage on the grid, there is no method for automated load balancing to prevent the system from failing. The SPARC project is specifically designed to address all of these issues and will provide dynamic or 'Smart' bi-directional communication between the producers and consumers.

**CS-08**  
**SocialSieve**

**Advisor:**      *Dr. Bruce Char*

Team:

Ben Carmichael	Computer Science
Erik Groch	Computer Science
Tim Higgins	Computer Science
Ben Jann	Computer Science

Social media is quickly becoming one of the world's most valuable sources of information about anything and everything having to do with public opinion, but combing through this information is too costly and time-consuming for most customers. SocialSieve is a software platform built from the ground up to give customers powerful tools for collection and analysis of social media data. Customers will use our unique web interface to enter the criteria that they'd like to examine, after which SocialSieve will begin to collect relevant information on their topics of interest in real time. Once data has been collected, it can be reviewed in one of three analysis views, which include heat maps, graphs, and simple tables where all of the information about individual social media actions can be viewed and filtered. SocialSieve is designed with an extensible architecture in mind, which means that new social networks and new analyses can be integrated to suit the needs of a rapidly changing market as social media continues to dominate.

## **CS-09**

### **FLIGHT - THE DREXEL RIDE**

**Advisor:**      *Dr. Paul Diefenbach*

**Team:**

Andrew Cory	Computer Science
Donny Hoang	Computer Science
Lou Manco	Software Engineering
Zach Thacker	Software Engineering
Mark Welser	Computer Science

ETC Inc.'s The Ride Works recently donated a reconditioned 3-DOF motion platform simulator/ride (XSpeed®) for use in classroom projects and research across Drexel University, with initial interest from Digital Media, ECE, CS, and MechE. The design of the motion capabilities (roll, pitch and heave) allows us to implement various entertainment rides. Two main problems with small simulator rides such as this are their high cost and general inability to involve many people. Consequently, a major goal of the project is to develop a networked, multiplayer game with the assistance of a team of Digital Media students. Up to five non-riders, using iPads, team up in order to stop the riders from going around the playing field and lighting beacons in a friendly game named fLight. A secondary goal is to derive a framework for future developers use to rapidly create new games for the platform.

## **CS-10**

### **AIRCRAFT FAILURE SIMULATION AND DETECTION**

**Advisors:**      *Dr. Bruce Char, Dr. B.C. Chang, MEM; Dr. Harry Kwatny, MEM;  
Dr. Mishah Salman, MEM*

**Team:**

Joshua DiCristo	Computer Science
Robert Shields	Computer Science
Boris Valerstein	Computer Science

In-flight loss of control is the largest contributor to fatal commercial jet airplane accidents worldwide. One of the principal issues in these accidents involve losing control of aerodynamic control surfaces, and pilots are not required by the Federal Aviation Administration (FAA) to undergo upset recovery training. In addition, pilots have no sense of their aircraft's position in relation to the horizon, which drastically impairs their ability to recover at all. As such, if control surface failure occurs during flight, pilots are ill-equipped to recover the aircraft. Our goal is to develop an application that utilizes simulated environments and a situational awareness model to educate pilots on how to recover from various degrees of control surface failure.

## **ECE-01**

### **LOAD LEVELING BATTERY ENERGY STORAGE SYSTEM**

**Advisor:**      *Dr. Chikaodinaka Nwankpa*

Team:

Praneeth Reddy Bogala	Electrical Engineering
Isaac Cyril	Electrical Engineering
Abin Prasad	Electrical Engineering
Pierre Simo	Electrical Engineering

In the power industry one of the main issues that utility companies face is how to effectively meet load demand. This proves to be extremely challenging, especially during peak hours of the day when power consumption is maximum.

The objective of this project is to achieve load leveling using a battery energy storage system (BESS). The specific system of choice may consist of lithium ion and lead acid batteries. In addition to the BESS, a utility and local load consumption connection is provided through an AC/DC power conversion system with associated monitoring and control equipment. The developed monitoring and control system evaluates and implements charging and discharging periods for the BESS while effectively leveling the load.

Load leveling via the BESS will help not only to improve the reliability of the grid, but will also eliminate the need for expensive peaking power plants and help amortize cost of generators over more hours of operation.

## **ECE-02**

### **WIRELESS DETECTION AND TRANSMISSION OF DIGITAL MOBILE MEDIA**

**Advisor:**      *Dr. Prawat Nagvajara, Dr. Adam Fontecchio*

Team:

John Basista	Electrical Engineering
Eric Lynch	Electrical Engineering
Nick Pirollo	Electrical Engineering/Computer Engineering

This group has designed a universal solution for sharing photos and PowerPoint presentations from a mobile device by use of a larger external display. Currently in the market, all wireless display functionality is essentially locked down by manufacturers, requiring manufacturer specific products in order to send and receive the correct data. Current universal solutions require wired connections between the device and screen/solution, which not all consumers have access to on-the-go.

With this project, it was required to devise a universal solution for most devices without the need for a wired or wireless network connection. Ease of use is also necessary, which is the reason for implementation of a swipe motion in order to connect the device to our solution.

This product will reduce the barriers to market by ease of use and reduction of infrastructure dependencies while being a universal solution for mobile media sharing.

## **ECE-03 RECORDING AMMETER FOR REMOTE DEPLOYMENT**

**Advisor:**      *Dr. Kevin Scoles, Dr. R. Barnett Adler, PECO Energy*

Team:

Sean J. Barag	Computer Engineering
Bryndon A. Blackburn	Electrical Engineering
Robert L. Cull	Electrical Engineering
C. William Hicks IV	Electrical Engineering

In response to industry need, a waterproof recording ammeter was developed for use by PECO and other electric utilities. Existing market offerings provide minimal protection against the wet and corrosive environments in which the products are typically used, and have user interfaces that are not easily understood by the engineers using them. These devices are sold for \$600-\$800, and often suffer catastrophic failures.

The device contains 4GB of non-volatile storage for current measurements, 4-6 weeks of battery life, and uses NEMA 6-rated parts for water protection. A standalone PC application and a Microsoft Excel plugin were created to make the device easily used in corporate computing environments.

Manufacturing costs are below \$300. A prototype with a resolution of 1A and a full- scale range of 2kA was deployed with PECO for testing, demonstrating the unit's capabilities. Feedback from deployment personnel and engineering staff on the unit's use was collected.

*Sponsor: PECO Energy*

## **ECE-05 HUMAN-ROBOT CHESS**

**Advisor:**      *Dr. Pramod Abichandani*

Team:

Evan Dissanayake	Electrical Engineering
Mayank Gureja	Computer Engineering
Anson Jacob	Electrical Engineering
Daksh Kapoor	Computer Engineering

Chess is a highly combinatorial game with both players trying to optimize their move at each step. Human-Robot Chess serves as an ideal platform to study the cognitive effects of human-robot interaction on game play. A low-cost, versatile robotic chess platform was achieved through this project. This platform consists of an inexpensive webcam, a 5 degrees of freedom robot arm, chess piece tracker software and an open source chess program.

All the components of this project - chess piece tracker software, the robot arm and the motion control code were built/implemented from scratch. A detailed outline of each of these components is available in our report.

After integrating the above-mentioned components, we were able to achieve our final product, which enables a human to play complete game of chess against the autonomous robot. Our final system tracks and plays all valid chess moves on the chessboard except for pawn respawning (needs human assistance) and castling.

## **ECE-06**

### **MULTI-LEVEL TRACKING FOR DYNAMIC AUGMENTATION OF LIVE PERFORMANCE**

**Advisor:**      *Dr. Youngmoo Kim*

Team:

Manu Colacot	Electrical Engineering
Julian Kemmerer	Computer Engineering
Matthew Zimmerman	Electrical Engineering

We have developed a system that uses visual tracking as well as audio based localization to allow performers to manipulate specific audio-visual parameters live while on stage. This is particularly relevant when considering that there are certain audio and visual effects, such as panning and reverb that are traditionally outside of a performer's control during a live event.

The objective of this project is to provide performers with a means to regain this control of their performance, through the use of real time audio-visual parameter manipulation. This has been accomplished by mapping various audio and visual features such as panning, volume control and novel visualizations, to motion sensor data gathered from multiple Microsoft Kinects.

In addition, audio triangulation through frequency masking has been implemented to find performer stage location, which has also been mapped to specific audio and visual effects.

## **ECE-07**

### **AUTOMATED FLAT LOAD PROFILE CONTROLLER**

**Advisor:**      *Dr. Chika Nwankpa, Mohammed Muthalib*

Team:

Taif Choudhury	Electrical Engineering
Mudit Dawar	Electrical Engineering
Ishaan Jena	Electrical Engineering
Deepesh Rana	Electrical Engineering

Currently, many commercial power- conserving devices rely on past power consumption data or load profile. Our objective was to design a real-time controller that does not use a predetermined load profile. This helps the power company to evenly distribute available power, hence reducing generation side strains without affecting normal household operations.

By controlling heaters at individual buildings, we have shown that it is possible to meet a given power level provided by the power company. The controller does not deviate from the comfortable temperature range specified by residents at each building.

We have 3 software-simulated buildings and 2 hybrid (combined hardware and software) setups which show that this is feasible. A user interface allows building temperature ranges to be set and graphically shows the individual and the total power consumption of these buildings. This will not only conserve power but will also save consumers and power companies money.

## **ECE-08 LOW COST SOLAR POWERED STREET LIGHT**

**Advisors:**     *Dr. Prawat Nagvajara*

Team:

Minzhi Chen	Computer Engineering
Kevin Hill	Computer Engineering
Kevin Siu	Computer Engineering

We have designed a low cost solar powered street light for the Drexel Smart House, a group dedicated to exploring the cutting edge of design and technology to improve the quality of life in the urban residential setting. The street light is constructed with two main goals in mind: improve the lighting around the Drexel Smart House and decreasing the carbon footprint left by streetlights. A problem that frequently plagues the area around the Drexel Smart House is poorly lit streets which results in a string of petty theft and crime. We hope to ameliorate this problem by using arrays of high brightness LEDs to create a brighter and safer environment for everyone. To decrease the carbon foot print and reduce the municipal cost, we have designed the streetlight with a solar panel to power the system and light and motion sensors to determine when the streetlights will turn on. This design results in a brighter and more cost-efficient street light that will improve the quality of life around the Drexel campus.

*Sponsor: Drexel Smart House*

## **ECE-09 DUAL SERVER MEDIA STREAMING**

**Advisors:**     *Dr. John Walsh, Dr. Steven Weber*

Team:

Yu-Chung Chau	Computer Engineering
Varoon Wadhwa	Computer Engineering
Jianbo Zhao	Computer Engineering

We have created a proof of concept of leveraging two independent network connections simultaneously on a client computer to view hi quality video from two servers via streaming. Streaming essentially allows the client device to view a video while the video is still being downloaded by the client.

For current electronic devices, video streaming or surfing the internet only uses one network connection but in our design, the client will pull chunks of the video alternatively from both of its connections to minimize buffer starvation (which minimizes wait time) to allow seamless hi quality video viewing over the internet (reducing video skipping and pauses during playback). Our implementation illustrates the benefits of using multiple network connections that already exist on a device. This concept can then be applied to devices such as laptops, phones, and modern electronics that can have multiple types of network connections such as WiFi and cellular network.



## **ECE-10 HIGH PERFORMANCE VIDEO CAMERA**

**Advisor:**      *Dr. Prawat Nagvajara*

Team:

Michael Ly	Computer Engineering
Phuc Pham	Computer Engineering
Alexander Roscoe	Electrical Engineering
David Tozour	Electrical Engineering

High-speed cameras are cameras that are capable of recording at high frame rates, allowing the slow playback of recorded data. We have designed a low-cost, high-speed, high- resolution video camera that operates at up to 340 frames per second (fps) at a resolution of 2048 x 1088 pixels. These types of cameras have applications in entertainment and science due to their ability to store a lot of data for later analysis. High performance cameras that are available on the current market tend to trade off resolution or speed at a high price tag. Vision Research Inc.'s Phantom Flex costs between \$50,000 and \$ 150,000 depending on features.

Our final product will cost around \$1000. The affordability of our high-performance camera offers everyday consumers and enthusiasts alike to make high-quality media available.

*Sponsors: Drexel Smart House, Lenovo, Linera*

## **ECE-11 ANDROID APPLICATION TO ENCOURAGE HEALTHY BEHAVIOR IN INDIVIDUALS WITH PREDIABETES**

**Advisor:**      *Dr. Mark Hempstead*

Team:

Thanawat Boonmee	Computer Engineering
Daniel Ciborowski	Computer Engineering
Aditya Puri	Computer Engineering
Jing Zhang	Computer Engineering
Shenglan Zhang	Computer Engineering

We have developed an Android application that is able to provide health monitoring for individuals with pre-diabetes. This application utilizes novel data entry techniques to provide the user with a more efficient experience. The first aspect of the app, diet entry, voice input and GPS data have been used to decrease the time taken for a user to input date. Having to spend less time entering data makes it more likely a user will continue to use the application. The second portion of the application, activity monitoring, is able to determine a user's activity level over a day by simply keeping the phone on the user. The phone is able to determine what the user has done during the day by analyzing the data collected from the accelerometer.

The application ties these two features together into one unified app, allowing for a user to easily track their health.

## **ECE-12 TABLETOP NUCLEAR REACTOR SIMULATOR**

**Advisor:**     *Dr. Christopher Peters*

Team:

Brian Abate	Computer Engineering
Matthew Marie	Electrical Engineering/Computer Engineering
Raghid Najjar	Mechanical Engineering
Romeo Ngate	Mechanical Engineering
Sherrod Williams	Electrical Engineering

There are resources available for interaction with nuclear reactors, although they are usually expensive. Many universities do not have access to the proper tools to allow students to interface with a nuclear reactor, Drexel University included. This senior design project involves the design, building and testing of an inexpensive nuclear reactor simulator that will allow for a reconfigurable model. The components of the nuclear reactor simulator will be a physical console for user input, a microcontroller to read user inputs to pass to the simulator software, simulator software which accepts external input and provides outputs based on the behavior of a nuclear reactor and a graphical user interface which will display the outputs in several different forms.

## **ECE-13 LOW COST EDUCATIONAL ROBOT**

**Advisor:**     *Dr. Pramod Abichandani*

Team:

David Binder	Electrical Engineering/Computer Engineering
Richard Clark	Electrical Engineering/Computer Engineering
Kacey Hoang	Electrical Engineering
Thao Le	Electrical Engineering

We have developed a complete low cost educational robotic ecosystem that introduces high school and college students to fundamental electrical and computer engineering concepts. Current offerings in this market are both expensive and closed source, which limit the target audience. Our ecosystem consists of a modular robot body, Arduino-based embedded systems, a visual integrated development environment (IDE), and a rich set of educational content. The ecosystem follows an open-source paradigm, enabling more advanced students to explore and modify the hardware and IDE.

## **ECE-14 RADIATION DETECTION UAV**

**Advisors:** *Dr. Christopher Peters, Dr. M. Ani Hsieh, MEM*

Team:

Arturs Bergs	Mechanical Engineering
Thomas Boyd	Electrical Engineering
Kevin Hall	Mechanical Engineering
Marko Jaćović	Electrical Engineering

Our team has designed and constructed a remote controlled data mapping UAV that detects nearby ionizing radiation. The device that has been constructed is for the purpose of indoor data collection, specifically to perform routine test measurements within a nuclear facility. Currently, health physicists have to enter in a nuclear facility and collect measurements by hand. With the use of the Radiation Detection UAV, the health physicist will be able to take measurements from a greater distance from the ionizing radiation. QR barcodes will be scanned to reveal the location at various checkpoints in order to find the UAV's position. Also, a Geiger-Muller counter will be used in order to detect any nearby ionizing radiation. This data will be sent through a wireless channel to the user terminal. A GUI will be utilized to allow for human interaction with the UAV.

## **ECE-15 DATAMAP - ANONYMIZED DATA COLLECTION AND ANOMALY DETECTION OVER A NETWORK OF WI-FI HOTSPOTS**

**Advisors:** *Dr. Steven Weber, Dr. Harish Sethu*

Team:

Justin Hummel	Computer Engineering
Andrew McDonald	Computer Engineering
Vatsal Shah	Computer Engineering
Riju Singh	Computer Engineering

The increase in usage of large wireless networks coupled with an increase in the quantity and complexity of cyber-attacks has created a need for better detection techniques. We have created a system to aid in the development of new anomaly detection techniques, which show promise to supersede signature-based techniques for network security. DataMap is an open and hardware-agnostic framework for distributed real-time traffic monitoring and anomaly detection. At its core, the system is built around vermont modules for capturing, aggregating, anonymizing, and storing data. No user data is ever stored, and privacy is further protected using Crypto-PAN, the standard for IP Address anonymization. The collected data is stored in a SQL database for access by researchers, but we have also provided a web interface and some simple analysis tools. DataMap is easily deployable – it follows the standard Linux install procedure, and the web interface provides an easy way to control the system once deployed in the field.

## **ECE-16**

### **TELEMETRY SYSTEM FOR FHSAE**

**Advisor:**      *Dr. Kevin Scoles*

Team:

Louis Bramante	Electrical Engineering
Tracy Faulkner	Electrical Engineering
Sam Hernandez-Gill	Computer Engineering
Ben Southammakosane	Electrical Engineering

We have designed and built a black box telemetry system and matching GUI that can be implemented with future FHSAE vehicles for competitions. The system reads motor temperature from a digital temperature probe, wheel speed via a hall sensor, and motor current, battery voltage, and state of charge from the battery management system (BMS). The system reports latitude and longitude using an internal GPS, acceleration using an inertial measurement unit (IMU), and altitude using a high resolution barometer present within the IMU.

The data obtained by the telemetry system is transmitted via RF to a stationary computer where the operator can use the LabVIEW GUI to monitor vehicle statistics. The system will be useful to future teams by allowing for more intricate comparison to theoretical performance and showing operation abnormalities, which will work towards early problem detection and damage prevention. The finished product is enclosed in a waterproof black box with minimum size.

## **ECE-17**

### **AUTOMATED TANK SWITCHER FOR LIQUID NITROGEN COOLING APPLICATIONS**

**Advisor:**      *Dr. Richard Primerano*

Team:

Earl Gorski	Electrical Engineering
Matthew Hoenninger	Computer Engineering
Tom McNeill	Electrical Engineering

We have designed and built an automated liquid nitrogen (LN2) tank switching system for Boeing. Boeing uses liquid nitrogen as a coolant when performing stress tests on parts and metals. The LN2 is stored in tanks that are connected to environmental testing chambers. Previously the tanks were opened one at a time and needed to be switched out manually.

Performance was an important factor when designing the device. The device needed to offer increased efficiency when switching between up to four LN2 tanks. A detailed breakdown of the selected hardware and capabilities of the system can be found in our report.

The tank switching system will be used during testing cycles involving LN2 at Boeing. The system will allow for tests to run without the need for an operator to be constantly on standby to manually switch out empty or faulty LN2 tanks. Along with switching between tanks, the system will display the LN2 levels of each tank.

**ECE-18**  
**FLEXINOL MASSAGING SLEEVE**

**Advisor:**      *Dr. Pramod Abichandani*

Team:  
Eric Dyke                                      Electrical Engineering  
William McIntyre                              Electrical Engineering  
David Wykes                                    Electrical Engineering

Shape-memory-alloys (SMAs) offer innovative methods of actuation via their shape-memory response to active heating. This project focuses on the design of a Flexinol-based sleeve for radial compression therapy for persons that suffer from diseases such as chronic venous insufficiency and lymphedema.

A small prototype sleeve will be used to demonstrate proof of concept. The user will be able to control compression amount, massage speed, and overall temperature from a graphical user interface. Real-time plots of sleeve performance will also be shown along side of the user interface.

**ECE-20**  
**AUTONOMOUS ON-STREET PARKING MANAGEMENT SYSTEM**

**Advisor:**      *Dr. Timothy Kurzweg*

Team:  
Jonathan Davis                                      Engineering  
Dakota Davis                                      Electrical Engineering/Computer Engineering  
Diego Pinate                                      Computer Engineering  
Niteesh Prasad                                      Electrical Engineering

Currently, the on-street parking process for cities and drivers is time intensive, costly and environmentally damaging. Our system streamlines the entire process creating an “EZ Pass for on-street parking” experience. We have designed a low cost, autonomous on-street parking management system for municipalities worldwide. Our system first senses a vehicle using a magneto-resistive sensor, then reads the customer tag with the RFID reader, processes that information through a microcontroller and transmits the on-street parking data through a cellular network to a central account database.

## **ECE-21**

### **INDUCT-A-BREW**

**Advisors:** *Dr. Vasileios Nasis*

Team:

Daniel Ackley	Electrical Engineering
Jason Ansert	Mechanical Engineering
Brian Curry	Electrical Engineering
Andrew Slothour	Electrical Engineering

We have designed an efficient, safe, and cost effective way to brew beer by induction heating called Induct-A-Brew. Commercial small scale and home brewing kits requires the use of gas to supply heat to the system, driving the cost of the operation and maintenance of the system up, while decreasing the heating efficiency of the system. Consequently, the precision of the temperature readouts of current systems makes it hard to precisely control the temperature of the liquid.

Safety and efficiency are the primary goals of our system while cost effectiveness and precision are secondary goals that contribute to our primary goals. Our final product excludes the use of gas in favor of electromagnetic induction found in commercial products to safely and efficiently brew beer, as per project requirements. A detailed outline of the system capabilities is available in our report.

The microcontroller will be used to control the heating elements as well as monitoring and precisely controlling the temperatures of the system. The cooling system is used as the last stage to condition the beer for fermentation.

## **ECE-22**

### **INTEGRATION AND ANALYSIS OF DISTRIBUTED GENERATION RESOURCES IN MICRO-GRID ENVIRONMENTS**

**Advisors:** *Dr. Karen Miu, Dr. Chika Nwankpa, Nicole Segal*

Team:

Michael Black	Electrical Engineering
Michael Caro	Electrical Engineering
Evan Greer	Electrical Engineering
Yi Li	Electrical Engineering

Two well-known methods of maintaining reliability are network reconfiguration and service restoration. One reason network reconfiguration is performed is to minimize a distribution system's real power loss as it serves demand and is achieved through the actuation of sectionalizing and tie switches. Service restoration is performed to deliver power to customers that are experiencing a outage.

This project created two algorithms: one that minimizes real power loss by determining a near optimal network configuration, and another that maximizes the amount of load restored in the event of a fault. The purpose of this project is twofold. First, the algorithms will serve as the basis of lab modules that can be incorporated in the current power engineering curriculum. Second, as more single and poly-phase distributed generation resources are introduced, complexities of NR and SR problems will increase, and algorithmic solutions will be needed.

## **ECE-23 ASSISTED LIVING MONITORING SYSTEM**

**Advisor:**     *Dr. Baris Taskin*

Team:

Jeffrey Eckert	Computer Engineering
Neev Wanvari	Computer Engineering

The Assisted Living Monitoring System brings needed technological advances into the assisted life-care industry through the implementation of a streamlined data-entry system, centralized backup database, real-time updates provided to secure authenticated guardians, and human-readable data presentation to assisted life care workers to aid in their job performance. The system operates through a web-based interface with account-delimited interface configuration and utilities. By utilizing the ALMS, the assisted life care industry can boost public confidence in their ability to perform their jobs.

This project will be presented with a real-time, live demonstration of the system using multiple platforms for interaction.

## **ECE-24 PRACTICAL APPLICATIONS OF INDOOR POWER HARVESTING**

**Advisors:**     *Dr. Kevin Scoles, Dr. Edwin Gerber*

Team:

Dustin Chapman	Electrical Engineering
Yin Huang	Electrical Engineering
Kunal Shukla	Electrical Engineering
Alexandria Walker	Mechanical Engineering

An indoor energy harvesting system, with input from typical compact fluorescent or LED light sources, has been implemented to power a networked room thermostat system for the Drexel Smart House. The Drexel Smart House is a student organization with the goal of encouraging environmental sustainability. The system designed is portable and reduces dependence on disposable batteries. The thermostat system consists of a temperature sensor, photovoltaic cells, an energy management system, a microcontroller, and a wireless communications system. After taking a temperature reading, the system then sends information back to a main device which then controls the heating and cooling systems of the house according to the set temperature by the user. The device is compact, aesthetic, and portable for use in multiple areas of the house.

**ECE-25**  
**SILVER RABBIT PACING LIGHTS**

**Advisor:**      *Dr. Prawat Nagvajara, Dr. Melton Silver*

Team:

Faisal Ahmed	Electrical Engineering
Adil Alasseri	Electrical Engineering
Abdulrashid Awali	Electrical Engineering
Antony Kipto	Electrical Engineering

The objectives of this project are design a system that has multiple sensory modalities that issued to monitor pace in distance running, Construct the designed system to aid athletes maintain pace during training, and lastly market the constructed Silver Rabbit Pacing Light System for distance training. The team has thought of solving the inaccurate running time duration by visualizing confirmation or representation of where on the track that athletes should be at any given time to maintain a given pace that would accomplish the target lap speed. So the desired goal is to design, manufacture and market a reliable training product to accomplish learning through multiple sensory modalities simultaneously (sight/sound and physical experience). In the previous term, one light box was constructed which was programmed to switch the light on for the input time. The goal for this term is to create another light box and to work with the first light box so the lights go off in a sequence for the given time. In addition, this term will focus on programming, which includes programming the light boxes to ensure they work with each other as well as testing, and debugging the system. Once this is accomplished, the wiring and components will be organized to give a pristine look for example, placing the lights, speakers and microprocessor into the project boxes in order for the product to look marketable.



## **MEM-01**

### **DESIGN AND FABRICATION OF AN ENVIRONMENTAL CHAMBER FOR MATERIALS TESTING**

**Advisors:**     *Dr. Jonathan Awerbuch, Dr. Tein-Min Tan*

Team:

Jonathan Kreamer	Mechanical Engineering
Kenneth Leibig	Mechanical Engineering
Nicolas Pizzuti	Mechanical Engineering
Timothy Steffel	Mechanical Engineering
James Sullivan	Mechanical Engineering

A novel environmental chamber has been designed, fabricated, and validated for testing bonded joints for aircraft applications. The project is sponsored by the Federal Aviation Administration (FAA) Technical Center, in Atlantic City. The environmental chamber is capable of testing the quality, strength, and durability of newly designed adhesively bonded joints under severe temperature, humidity, and corrosive environments experienced by today's transport aircraft. The capabilities of the new chamber, as specified by the FAA-TC, include: heating up to 350°F, cooling down to -65°F, humidity range from 10% to 95% relative humidity, and a corrosive salt fog environment up to 5% concentration, as required for bonded joints certification. Based on extensive theoretical analyses the solutions selected for each sub-system are: finned cartridge heaters for heating, liquid nitrogen for cooling, pressurized Venturi nozzles for humidification and corrosion, and a PC-governed, user-friendly control system. The prototype of the fully functional chamber was delivered to the FAA-TC.

*Sponsors: Dr. John Bakuckas, Federal Aviation Administration; William J. Hughes, Atlantic City International Airport*

## **MEM-02**

### **DESIGN OF AN EXPERIMENT: ADHESIVE BONDING STRENGTH BETWEEN GLASS MIRROR AND ALUMINUM FRAME**

**Advisor:**     *Dr. Jonathan Awerbuch*

Team:

David DeMaria	Mechanical Engineering
Donald Lozzi	Mechanical Engineering
Jerry Rava	Mechanical Engineering
Matt Tyrrell	Mechanical Engineering

The goal of this project is i) to design and fabricate a low tech/low cost test apparatus and experimental methodology to characterize the bonding of glass panels to aluminum frames used in the particular assembly installed in the M-series bathroom cabinet produced by Robern Inc; and ii) to conduct a series of tests to determine the bond quality under three different loading conditions (namely, normal, shear, and shear/creep) for bonds fabricated under different surface preparation, temperature, pressure, and humidity conditions.. The newly designed test procedure should provide reproducible and reliable test results. The project was limited to the use of Robern's-available equipment and was targeted specifically for Robern's future usage. The test matrix was based on The 3M-Co. manufacturing standards. The test procedure developed herein and validated via the test matrix enable Robern to optimize its future manufacturing and testing procedures.

*Sponsors: Robern Inc., Bathroom Cabinet and Vanity Division of Kohler Co.*

### **MEM-03**

#### **AIRCRAFT TRAFFIC COLLISION AVOIDANCE SYSTEM (TCAS)**

**Advisors:** *Dr. Bor-Chin Chang, Dr. Harry Kwatny*

Team:

Arayfin Abedin	Mechanical Engineering
Abhishek Ghosh	Mechanical Engineering
Nandip Gohel	Mechanical Engineering
Stefan Rojas	Mechanical Engineering

This project is focused on creating an autonomous leak detection device for a water distribution system. We propose that an autonomous leak detection method can mitigate water and financial losses more efficiently than the non-autonomous leak detection methods currently used in the water industry. The project will be divided into 3 focus areas; with this team developing the subsystem to continuously determine and record the device's position in the water system. Deliverables for this project include the subsystem's working code in the Arduino programming language, examples and analysis of the code's recorded position data with and without filters, and a prototype of the subsystem hardware; consisting of 3 positioning sensors an Arduino Duemilanove microcontroller, and a MicroSD storage device. The accuracy of the subsystem's localization data is reliable up to the maximum speed of the transport device, and has a leak positioning error at least equal to the accuracy of the leak detection subsystem.

### **MEM-04**

#### **AUTOMATED MIXED DRINK DISPENSER**

**Advisor:** *Dr. Bor-Chin Chang*

Team:

John Benko	Mechanical Engineering
Mark Brandon	Mechanical Engineering
Kyle Brenneman	Mechanical Engineering
Peter Patchoski	Mechanical Engineering

The automated mixed drink dispenser allows the bartender to enter a drink order and put a cup into one of several cup slots. The machine then dispenses the drink into the cup, while the bartender takes care of money transaction, beer, and ad-hoc drinks. This speeds up the transaction by freeing up the bartenders time, standardizes the amounts of product that is put into a drink, and allows for simple inventory tracking for the bar owner. Since bars use an industry standard for soft drinks and mixers of the bag in a box system racks, the product ties seamlessly into this setup. The bar is able to fill up six reservoirs, which are suspended overtop of the cups and the dispenser, with any liquors, or mixed liquors of choice. This way, the bar can turn out a high number of their most popular drinks, at a very fast pace.

**MEM-05**  
**AIRCRAFT FAILURE SIMULATION AND CONTROL**

**Advisors:** *Dr. Bor Chin Chang, Dr. Mishah Salman*

Team:

Christopher Braun	Mechanical Engineering
Justin Warren	Mechanical Engineering

In-flight loss of control (LOC) is the largest contributor to fatal commercial jet airplane accidents worldwide. The two primary contributors to this crash category are losing control of aerodynamic control surfaces and stall upsets. This project focuses on understanding the aircraft fault dynamics and creating control strategies that incorporate fault knowledge to stabilize the aircraft. By characterizing the aircraft dynamics and implementing control strategies, the tool will instruct and guide pilots to the correct course of action.

**MEM-06**  
**HEART RATE VARIABILITY**

**Advisor:** *Dr. Young I. Cho*

Team:

Rich Blevins	Computer Engineering
Robert Carroll	Electrical Engineering
Sean Finnerty	Computer Engineering
Lucille Gassner	Mechanical Engineering
Matthew Nial	Mechanical Engineering
James Teti	Electrical Engineering

This project focuses on heart rate variability (HRV) and the capability of non-invasively diagnosing cardiac health issues in a patient through the study of this variation. Typically, heart diseases are tested by highly trained technicians with expensive equipment. Professor Young I. Cho has proposed a device which will measure a patients' HRV through the index finger, wirelessly. The transferred data will be analyzed in the time domain as well as the frequency domain and feedback will be provided to the patient's physician for diagnosis. A team of engineering students will design this product by obtaining the heart beat through an oximeter and design a housed processing system to wirelessly connect to computers and smart phones. Applications for capturing and analyzing the data are being designed for Android and iPhone systems. A successful final design will be effective, affordable, lightweight, and easy to use with as little instruction necessary.

**MEM-07**  
**EFFICIENT EASY-ACCESS REFRIGERATOR**

**Advisor:**     *Dr. Young Cho, Michael Glaser*

Team:  
Greg Hoge                             Mechanical Engineering  
Dennis Ruiz                         Mechanical Engineering  
Daniel Sermier                       Mechanical Engineering  
James Waweru                        Mechanical Engineering

A large number of the household refrigerators currently on the market contain hard-to-reach places, particularly in the back of the fridge, where items can be neglected for long periods of time. Additionally, many household refrigerators could be made more energy efficient using existing technologies. In this project, we sought to develop a more easily-accessible and more energy efficient household refrigerator. We conducted user surveys and accessibility studies along with thorough market research on current refrigerators. We innovated a refrigerator door and interior design that maximizes user access to all items in the fridge. With prior published research as a guide, we developed a refrigeration system design that includes a custom phase change material in the evaporator to reduce energy consumption. Finally, we fabricated a prototype that we tested, providing proof-of-concept for both the energy efficiency, and increased accessibility of our design.

*Sponsor: Drexel Smarthouse*

**MEM-08**  
**DESIGN AND CONSTRUCTION OF A SUPERCRITICAL FLUID CO<sub>2</sub> FLOW REACTOR**

**Advisors:**     *Dr. Bakhtier Farouk, Nusair Hasan*

Team:  
Anubhav Gupta                       Mechanical Engineering  
Dipankar Shrigyan                   Mechanical Engineering  
Christopher Weidner                 Mechanical Engineering

The task of the group was to design, construct, and test an affordable supercritical CO<sub>2</sub> (SC CO<sub>2</sub>) flow reactor for experimental research. According to our stakeholder's needs, and required conditions for SC CO<sub>2</sub>, parameters were set to operate at pressures and temperatures ranging between 1070 and 2000 psi and 31.1°C to 50°C respectively. The CO<sub>2</sub> needed to be cooled, heated, as well as highly pressurized at during different sections of the flow reactor. Compared to a static reactor, the constant flow reactor increases the amount of solute, such as caffeine from coffee beans, that can be extracted from the given plant matter. The time required to complete the extraction is also shortened. Preliminary testing confirmed the operability of the flow reactor. A mass transfer experiment was run as a trial for baseline data. Future experiments will introduce acoustic excitations to the reaction chamber to further reduce time and increase yield.

## **MEM-09**

### **DESIGN, FABRICATION AND INSTRUMENTATION OF A THERMOACOUSTIC HEAT ENGINE**

**Advisor:**      *Dr. Bakhtier Farouk*

Team:

Shubham Gupta	Mechanical Engineering
Nick Meghri	Mechanical Engineering
Ian Murphy	Mechanical Engineering

The group designed and constructed a traveling wave thermoacoustic heat engine. The engine was operated by thermoacoustic conversion of thermal energy to acoustic energy, in the form of a pressure wave, using high pressure helium as the working fluid. This energy conversion was achieved by establishing a critical temperature gradient across a regenerator within the working fluid through the direct addition of thermal energy. The pressure wave was utilized to perform work on a piston, driving a visual output such as a linear alternator. Presently, groups such as the Environmental Protection Agency and Department of Energy have a demand for methods of energy generation that do not require combustion and can be operated at high levels of efficiency. Thermoacoustic heat engines operate purely on an applied temperature gradient, can potentially operate at efficiencies of up to 30%, and could be an effective strategy for waste heat recovery.

## **MEM-10**

### **ADAPT CATAPULT DEAD LOADS TO USE NOSE GEAR LAUNCH BAR**

**Advisor:**      *Dr. Leonid Hrebien*

Team:

Sean Carlson	Mechanical Engineering
Amanda Guertin	Mechanical Engineering
Chris Gulick	Mechanical Engineering
Kevin Peters	Mechanical Engineering
Thomas Salvesen	Mechanical Engineering

At the NAVAIR site in Lakehurst, New Jersey, engineers work with a steam catapult system to simulate the ones found on aircraft carriers used by the United States Navy. These catapults use dead loads that represent the weight, sizes and mannerisms of the actual aircrafts. At this time they use a bridle system to connect the catapult and dead loads which is very unrealistic. The Navy is looking for a system that will utilize the aircraft launch bar to better model the on-board system. By analyzing the forces and accelerations of the system, a solution was found incorporating this launch bar onto the dead loads. The final product is a design that will incorporate the aircraft launch bar into the dead load system using a newly designed bracket and remote actuation system. This new design will allow the tests done by the Navy to be more accurate, realistic, and safe.

## **MEM-11 UNMANNED AERIAL VEHICLE FOR INFRASTRUCTURE EVALUATION**

**Advisors:** *Dr. Antonios Kontsos, Dr. Ivan Bartoli, Dr. M. Ani Hsieh*

Team:

Lara Branco	Mechanical Engineering
Andrew Ellenberg	Mechanical Engineering
Alison Krick	Mechanical Engineering

With the recently passed bill allowing drones to fly in the United States in 2015, drones applications are a major focus of current research. Drones capable of performing inspection will provide safety and technological advances. Current inspection techniques are inconvenient and can involve high risk during emergency situations. Providing inspection personnel with UAVs will decrease safety risks and provide consistent data for analysis. To create a three-dimensional model of the target and structure, the device will use optical metrology and/or 3D SLAM (simultaneous localization and mapping). The drone can be used for visual inspection, and the captured data for deformation analysis. Several tests were performed to validate the team's original MATLAB algorithm used with the prototype drone system. Data was captured statically and in flight. The algorithm was compared with other methods including TRITOP, a commercial software that captures 3D geometry; and 3D SLAM, which was explored via Xbox Kinect.

## **MEM-12 DESIGN OF AN ELECTROCHEMICAL FLOW CAPACITOR TEST SYSTEM**

**Advisor:** *Dr. Emin Caglan Kumbur*

Team:

Arvind Kalidindi	Mechanical Engineering
Ahmet Cecen	Mechanical Engineering
Kenneth King	Mechanical Engineering

The electrochemical flow capacitor (EFC), a technology recently developed at Drexel University by the Electrochemical Energy Systems Laboratory and the A.J Drexel Nanotechnology Institute, has the potential to facilitate widespread usage of alternative energy sources in the power grid due to its unique scalability and high power density (10x batteries). However, in order for EFCs to be commercially viable, significant improvements in performance, durability, and cost must be achieved. To assist growing research efforts, our team has developed an EFC testing system that uniquely features automated slurry flow, while also facilitating experimentation through automated data measurement and acquisition. The EFC testing system includes: i) a specially-designed, low-cost pumping system to minimize damage to slurry particles while maintaining constant flow, ii) a clamping system for rapid assembly of EFC test cells, and iii) an automated control system for greatly improved repeatability and significant time and cost savings.

**MEM-13**  
**MOTORCYCLE LAND SPEED RECORD: FLYING DRAGONS II**

**Advisors:**     *Dr. John Lacontora, Ryan Miller*

Team:

Domenic Arnone	Mechanical Engineering
Michael Ferrino	Mechanical Engineering
Jordan Kimelman	Mechanical Engineering
Russell Montana	Mechanical Engineering
Mark Rogers	Mechanical Engineering

Last year, the original Flying Dragons team built a custom motorcycle and set the land speed record for a 100cc engine certified by the East Coast Timing Association. This year, the goal was to redesign and modify last year's motorcycle and break the current record of 82.053 miles per hour in the A-G-100 class. The redesign included emphasis on reducing weight, increasing power, and improving aerodynamics. Top speed was increased by decreasing rotational and static weight, improving the fuel to air ratio, and streamlining the motorcycle. Redesign also included modifications to the chassis, brakes, cooling, suspension, shifting, and wiring. The ultimate goal of the project was to partake in the annual Speedweek event held at the salt flats of Bonneville, Utah in August of 2013.

**MEM-14**  
**AUTOMATED NETWORKED TRANSPORT SWARM, STEERING TEAM**

**Advisor:**     *Dr. John Lacontora*

Team:

Peter Costello	Mechanical Engineering
Robert Edwards	Mechanical Engineering
Daniel Sloan	Mechanical Engineering
Christopher Van Sant	Mechanical Engineering

The United States Navy (USN) is looking for ways to save money, and decrease the manpower required to operate its fleet of Nimitz class aircraft carriers. In order to accomplish this goal both the USN and NAVAIR are looking for ways to automate routine shipboard tasks, such as the movement of ordinance. Currently most munitions are moved, from the magazines to the flight deck, using the MHU-191 transporter. This unpowered cart can require up to nine Aviation Ordnancemen to safely operate, in its present state.

The goal of our design team was to engineer a compact power steering system that will help reduce the MHU-191's overall manpower requirements. The solution we devised utilizes a 12VDC electric motor, and a 50:1 worm gear drive to produce the torque required to steer up to a 5000lb load. Our system is easily installed, and designed to ensure safe use.

*Sponsor: Naval Air Systems Command (NAVAIR)*

## **MEM-15**

### **AUTOMATED NETWORK TRANSPORT SWARM (ANTS) – POWER SUPPLY**

**Advisor:**      *Dr. John Lacontora*

Team:

Andrew Benner	Electrical Engineering
Andy Bui	Electrical Engineering
Jennie Huh	Electrical Engineering
Leslie Muluh	Electrical Engineering
Henry Wong	Mechanical Engineering

Aboard United States aircraft carriers, a significant portion of the crew is utilized to transport weapons through the ship onto the flight deck. The objective of the Automated Network Transport Swarm (ANTS) Power Supply is to design a power supply to service the ANTS Hardware Capstone prototype of a MHU-191 conversion kit. The design must be modular, mindful of budget, while keeping all components within the footprint of the original MHU-191 cart. The additions to the prototype has culminated to at rechargeable DC power source delivering single phase AC power to two AC Servo motors, via the use of inverters, in order to safely move the cart with a weapons payload to assist sailors with movement of ammunition from the magazine to the flight deck.

*Sponsor: NAVAIR*

*Acknowledgements: Baldor, Precision Systems*

## **MEM-16**

### **CHARACTERIZATION OF A HYBRID OR ELECTRIC DRIVE SYSTEM FOR A MOTORCYCLE**

**Advisors:**      *Dr. John Lacontora, Dr. Christopher Peters*

Team:

James Azar	Engineering
Bryan McManus	Mechanical Engineering
William Naylor	Mechanical Engineering
Walter Riskie	Mechanical Engineering
Zachary Zervas	Mechanical Engineering

With today's societal stance on foreign energy rapidly shifting to domestic and the necessity for renewable sources of energy quickly increasing, we have identified a need for a means of hybrid transportation that both increases performance and energy efficiency, while maintain minimal and/or zero emissions. Our team was appointed to design and build this high-performance alternative energy drivetrain that would be capable of competing with similar combustion race motorcycles. Our sponsor, IMR, is a leader and innovator in the motorcycle-racing industry. Working closely with him and other experts in the industry, our team developed specific structural components necessary to have a functioning motorcycle, such as elaborate bracketry and component cradles as well as complicated wiring harnesses to have a fully functional system. Our deliverable was a prototype motorcycle that is a proof of concept for what proved to be a fully functional and sustainable electric motorcycle.

*Sponsor: IMR - Innovative Motorcycle Research*



**MEM-17**  
**NAVAIR AUTOMATED FLIGHT DECK CART TUG**

**Advisors:**     *Dr. John Lacontora*

Team:

Matthew Bloise	Mechanical Engineering
Derek Cruice	Mechanical Engineering
Paul Jacques	Mechanical Engineering
Kevin McMahon	Mechanical Engineering
Maarten Naeff	Mechanical Engineering
Caleb Stoval	Mechanical Engineering

NAVAIR uses an MHU-191 weapons skid to transport ammunition from inside the ship up to the flight deck. The skid can weigh up to 5,000 lbs. and requires 3-4 sailors to manually push, pull and steer it to the desired location. NAVAIR would like to mechanize this transport to decrease the amount of required sailors and begin to take steps towards complete automation of the transportation system. Our solution was to design, fabricate, and test an automated all-purpose tug that pulls these skids using a remote control to decrease the required manpower down to 1-2 sailors. This was achieved by building a cart complete with two brushless AC servomotors, a control system, and enough battery power to operate continuously for 45 minutes without recharging.

*Sponsor: NAVAIR*

**MEM-18**  
**LOW WIND VELOCITY ELECTRICITY GENERATING TURBINE**

**Advisor:**     *Dr. Alisa Morss Clyne*

Team:

Yuqing Dai	Electrical Engineering
Tyler Kovitch	Mechanical Engineering
Adrian Libiszowski	Mechanical Engineering
Praveen Narangoda	Mechanical Engineering

Wind Power is a growing source of renewable energy with zero-carbon emission. Along with it the demand for localized low-velocity wind power generation is also increasing. This project was a proof-of-concept design and analysis of a wind turbine where a critical fluid dynamic component was incorporated into a vertical axis wind turbine, to amplify the power of low-velocity winds reaching the turbine blades by a factor dependent on inlet/outlet areas of the critical component. Project had 3 focus areas; critical component, controls, and electrical system. The team designed and fabricated a prototype under \$ 1000 for testing and validation. At the end of testing, the team was able to verify that the critical component amplify the power output by a factor 2.0, compared to the theoretical factor 3.0. Along with the prototype, the team developed a feasibility study with potential materials, components, manufacturing methods and cost analysis.

*Sponsor: Mr. Herman Joseph Engel*

**MEM-19**  
**DIRECT REPLACEMENT LED MODULE FOR VEHICLE HEADLIGHTS**

**Advisor:**      *Dr. John Locontora*

Team:

Frank Arena	Mechanical Engineering
Brandon Derr	Mechanical Engineering
Adrian Ferraro-Varvoutis	Mechanical Engineering
Rebecca Santoro	Electrical Engineering
Todd Smith	Mechanical Engineering
Steve Wilchek	Mechanical Engineering

The intent of this project is to develop a lighting module for a vehicle utilizing the latest power LEDs capable of being installed in an existing vehicle with no modifications needed. The device will utilize SAE standards for halogen light sources to develop an optical model for a guideline. The final product will require no adapters or adjustments to be installed and will provide the same lighting intensity as traditional halogen bulbs currently do.

Success of this project will not only rely on the lumens produced out the front of the vehicle, but also on the LED package's temperature and estimated lifespan. The main benefit most will expect when switching to an LED light source for vehicle headlights is lower power consumption and longer product life - both of which need to be satisfied in this design

*Sponsor: Boeing*

**MEM-20**  
**SOLDIER PROTECTION IMPACT TESTING INSTRUMENT**

**Advisor:**      *Dr. Leslie Lamberson*

Team:

Ryan Beck	Mechanical Engineering
Libu Geevarghese	Mechanical Engineering
Daniel Salvatore	Mechanical Engineering
Dominic Sciulli	Mechanical Engineering
Benjamin Wright-Rowan	Mechanical Engineering

In many countries where American military presence is felt, the use of improvised explosive devices have drastically increased over the past decade and impeded soldiers from successfully completing their missions and returning home. One of the qualities of an IED is that the debris formed by their explosions often varies in terms of velocity, size and material. In order to be able to improve the performance of the armor that soldier s wear during combat, each of these variables must be explored. To do so, a single stage light gas gun was developed that has the flexibility to change out material size, type and the ability to adjust the velocity of the projectile. Using different thermodynamic and gas dynamic principles, a final design was mathematically determined and a model of the prototype was generated. Components for the gas gun were then ordered and assembled and material testing was initiated.

**MEM-21**  
**THE ART OF CORTICAL BONE DYNAMIC FRACTURE**

**Advisor:**      *Dr. Leslie Lamberson*

Team:  
Matthew Guedon                      Mechanical Engineering  
Kyle Huang                              Mechanical Engineering  
Cheung Lo                                Mechanical Engineering  
Ryan J. Powell                          Mechanical Engineering  
Manouchehr Sabeti                      Mechanical Engineering

While information exists on the biological and physiological process involved in stress fractures, very little information exist which focuses on the dynamic fracture properties of cortical bone. An interest in unique dynamic loading profiles has been achieved through study of the locomotion of ballet dancers and basketball players. A strain gauge based force plate has been constructed to gather these loading profiles to study the force measurements of the unique impact loading. This experimental data was then analyzed to obtain the impulse experienced during performance and then recreated during a Kolsky Bar test using dry feline cortical bone. A bone rig has also been constructed to test bone impact in different orientations other than the conventional uniaxial and transverse directions. Data gained from this research is hoped to be useful for military personnel undergoing evacuation from helicopters and may result in the formation of preventative measures for the athletic community.

**MEM-22**  
**S.P.W.P.S. (SOLAR POWERED WATER PURIFICATION SYSTEM)**

**Advisor:**      *Dr. Roger Marino*

Team:  
Tony Martin II                          Mechanical Engineering  
Christopher Brown                      Electrical Engineering  
Galen Johnson                          Mechanical Engineering  
Anmed Banya                              Electrical Engineering

There is an ongoing problem in Haiti where half of the population lacks access to clean potable water. One example would be the fresh water Lake of Miragoane, which has the highest coliform count in Haiti making it un-accessible to the surrounding communities that depend on it. In order to combat this issue we developed a portable water purification system, which has been proposed to the embassy of Haiti for implementation at the lake. Our water purification system was designed to treat water at a flow rate of .5gal/min using a rapid sand filter to remove suspended solids, and two germicidal lamps to provide a 99.99% reduction of all bacteria, viruses, and protozoa. The water flow is controlled by two 12V solenoids connected to an Arduino Duemilanove microcontroller. This is powered by a 12V battery that is recharged by a solar panel to make use of sustainable energy.

## **MEM-23 RAINWATER RECYCLER**

**Advisor:**     *Dr. Roger Marino*

Team:

Kirt Hammond	Mechanical Engineering
Benjamin Harris	Mechanical Engineering
Brian Trethaway	Mechanical Engineering

Fresh drinking water is in short supply on Earth. Most residential sprinkler systems are inefficient and waste countless gallons of drinkable water. To improve efficiency, the group focused on preventing sprinklers from overwatering lawns. Additional water savings comes from rainwater harvesting to lessen the environmental impact. The solution is the Rainwater Recycler, an Earth friendly sprinkler system modification. The project saves water in two ways. First, moisture sensor technology prevents unneeded watering. Second, rainwater is harvested from a roof into a tank and pumped into a pre-existing sprinkler system. Minimal user interaction is required by the Rainwater Recycler. The Rainwater Recycler uses several LED lights to notify the user of the current system function and errors. The system can switch to public or well water during dry weather. Overflow pipes were used to protect the foundation of the house. The Rainwater Recycler saves water without sacrificing a lush green lawn.

## **MEM-24 SIGMA STOVE**

**Advisor:**     *Dr. Roger Marino*

Team:

Joseph Dugan	Electrical Engineering
Joshua Peditto	Mechanical Engineering
Eric Ryan	Mechanical Engineering

The Sigma Stove is a concealable stove with a purpose of space efficiency with integrated safety, and is focused towards modern, sleek, urban renewals and developments. From research done in 2007, one of the main causes of household fires originated from the kitchen with stovetop cooking. To insure that the design of the product serves the safety needs of the stakeholders; home developers and homeowners, the design included temperature-monitoring devices along with optic sensors that promoted its auto shutoff functions. In current architectural development, space efficiency is a very important concern in urban/city living. The design of the Sigma Stove allows more countertop space in the kitchen to be utilized. This was accomplished by having a modified electric stove top on lowering hinges, which allowed a user to fold the stove upright into a wall. In this position the stovetop is fully encapsulated and without power when not in use.

*Sponsor: Marlton Pike Precision*

**MEM-25**  
**NOVEL INTERACTIVE PLAYGROUND EQUIPMENT**

**Advisor:**      *Dr. Alexander Moseson*

Nandnee Bhudia	Mechanical Engineering
Kevin Capps	Mechanical Engineering
Shawn Davis	Mechanical Engineering
Mathew Gordon	Mechanical Engineering
Anthony Spurlino	Mechanical Engineering

Playground equipment has been relatively unchanged for over a century. Our sponsor, Ben Allen, approached Drexel with the goal of creating the next trend in interactive playgrounds. This playground equipment was developed to help motivate children to exercise. The equipment was designed to accommodate children ages 8 to 12, who typically play in schools and parks. In order to come to our final concept the Engineering team collaborated with a Product Design class to produce potential concepts. An evaluation of each of the concepts was carried out by the engineering team. A system of intuitive and pairwise weights, supplied by the engineering team and the project sponsor, were used to evaluate the top concepts. Once a decision regarding final concept selection was made the detail design process of force analysis, biometric analysis, material & parts selection, prototype pricing, and the assembly process was conducted.

*Sponsor: Ben Allen*

**MEM-26**  
**SUSTAINABLE DEVELOPMENT FOR BO KLUA THAILAND: CLEAN WATER**

**Advisor:**      *Dr. Alexander Moseson*

Team:	
Kevin Friel	Mechanical Engineering
Timothy Horcher	Mechanical Engineering
Aidan Horng	Mechanical Engineering
Zhi Ren	Mechanical Engineering
Reginald Smith	Mechanical Engineering

30,000 subsistence farmers in remote Bo Klua, Thailand do not have access to clean water. Their water sources are contaminated with many physical and biological contaminants, particularly E. Coli. Our team developed a solution using a sustainable “technology seeding” approach. Thus, solutions were developed in collaboration with the farmers, and designed to be built and maintained locally. Extensive research was initially performed to determine all possible water purification solutions. Using a decision matrix that took into account all relevant needs and specifications, the biosand filter was selected. Our team paid particular attention to WHO clean water requirements and the socio-economic background of the region. Eight prototypes were built to gain a parametric understanding of how the biosand filter operates. Using our experimental data, an optimized design was developed and built in Bo Klua for demonstration purposes. A permanent unit was also installed at the Center for Sustainable Development in Thailand.

## **MEM-27**

### **SUSTAINABLE DEVELOPMENT FOR RURAL THAILAND: IMPROVED RICE PLANTER**

**Advisor:**      *Dr. Alexander Moseson*

Team:

Robyn Cook	Mechanical Engineering
Russell Dubbs	Mechanical Engineering
Mike Hyduchak	Mechanical Engineering
Rich McKay	Mechanical Engineering
Alex Migdalias	Mechanical Engineering

This project continues the established Drexel Thai Harvest program and their design work. 30,000 subsistence farmers in remote Bo Klua, Thailand suffer from hard labor, tedious tasks, and low yields. They farm on steep terrain with basic tools and experience various musculoskeletal problems as a result. Thus planting the annual rice crop is an especially critical, time-sensitive, and stressful period. The three main problems that need to be addressed are the physical health of the farmers, increasing the yield from the annual rice harvest and making the planting process more efficient, in terms of saving time and energy. Taking these challenges, this team worked on designing a more efficient rice planter for use in Bo Klua. Based on previous research into this topic, the group has developed concepts and has run through several iterations attempting to optimize the device. As a result, we have developed a more efficient planter in hopes of improving current rice farming techniques.

## **MEM-28**

### **ENHANCED MANUFACTURING**

**Advisor:**      *Dr. Alexander Moseson*

Team:

Mike Courtney	Mechanical Engineering
John Halko	Mechanical Engineering
Mark Kuhn	Mechanical Engineering
Sean Rossiter	Mechanical Engineering
Luc Tenthorey	Mechanical Engineering
James Vescio	Mechanical Engineering

Philly Pretzel Factory has identified a new means to distribute their popular, local staple in the vending machine market. Since no relevant automated device exists to store, heat and vend baked goods, a machine was designed and fabricated to fulfill and surpass the needs of this well-established baking company. A proof-of-concept machine was constructed that maintains pretzels at freezing temperatures, transports them safely throughout the machine, heats them to serving temperature, coats them with salt and finally delivers the pretzel to the customer individually packaged, with his or her choice of condiment. Each phase is accomplished using food safe practices outlined by NSF standards, drawing electricity within US regulations and maintaining the quality of the pretzel all within the footprint of a vending machine in less than one minute. The machine was designed with rapid commercialization in mind to ultimately fulfill business goals of the project's sponsor, Philly Pretzel Factory.

*Sponsor: Philly Pretzel Factory*

## **MEM-29**

### **ENVIRONMENTAL DEPENDENT MEDIA DISPLAY PLATFORM**

**Advisor:**      *Dr. Mishah Salman*

Team:

Jeff Budzinski	Computer Engineering
Keyur Jain	Mechanical Engineering
Stephen Pechacek	Mechanical Engineering
Nick Santamala	Electrical Engineering

We feel the old methods of advertising are archaic; the idea of bombarding the public with content and hoping that it will hit a target audience is an outdated system. We created an interactive digital media outlet capable of collecting environmental data and using this collected information to select appropriate displayable content by means of Ciright Inc's content selection algorithms. Through a partnership with Ciright Inc. we are introducing the new paradigm for which advertisers will be displaying their content. The device will run computer vision algorithms created by the senior design team in order to allow interaction through a gesture based interface. This style of interface was chosen because it is a much more natural way of communicating, and leaves behind the redundancies of clicking, tapping and typing. We are providing our clients with the ability to optimize their advertising campaigns through ensuring their digital content reaches its desired target audience more effectively.

*Sponsor: Ciright Inc.*

## **MEM-30**

### **MOTORIZED GIMBAL MOUNT FOR MICROPHOTOGRAPHY**

**Advisor:**      *Dr. Mishah Salman*

Team:

Abdelkaoui Abdelkaoui	Mechanical Engineering
Kartikey Dadoo	Mechanical Engineering
Paul Holleger	Mechanical Engineering
Aaron Krick	Mechanical Engineering
Robin Rehmat	Mechanical Engineering

The Academy of Natural Sciences of Drexel University in Philadelphia (ANSP) currently has a grant to photograph tens of thousands of mollusk specimens in several orientations for archival purposes. However, many of these specimens are quite small, fragile, rare, and are decades and centuries old, and previously existing methods of photography caused damage to these specimens. In order to solve this problem, several concepts were generated to photograph the specimen in any desired orientation, and the concept that best met the needs of ANSP was chosen. Automation of the device was accomplished using C++ and Arduino programming languages, while physical design was accomplished in Creo. We have designed, built, programmed, tested, and delivered a vacuum powered suction mount capable of automatically rotating, with two servo-controlled degrees of freedom, a specimen into any desired orientation for photography.

*Sponsor: Academy of Natural Sciences of Drexel University*

## **MEM-31 MULTI-DIRECTIONAL, LIQUID MIRROR TELESCOPE**

**Advisors:** *Dr. M. Ani Hsieh, Dr. David Goldberg*

Team:

Alicia Andrescavage	Mechanical Engineering
Joseph Boales	Mechanical Engineering/Physics
Clara Engel	Mechanical Engineering
Michael Oake	Mechanical Engineering

For hundreds of years, people have been studying the stars. The primary tool used for these studies is a telescope. For these telescopes to be useful for modern research purposes, they need to collect large amounts of light, which means increasing the aperture size, which is often prohibitively expensive. Therefore, there is a need for a low-cost, research-grade telescope for low-budget astrophysicists, astronomers, and universities with such programs.

Conceptual designs were developed using the concept of a liquid parabolic mirror telescope. Current liquid-mirror telescopes only have the ability to view the sky upward. Therefore, we proposed alternative designs to view the sky in multiple directions, making it more useful for astronomical purposes.

A frame-based, dual mirror design was decided upon, which includes a liquid mirror and multi-directional capabilities. Detailed design included the construction of an operational, one-third scale prototype of the multi-directional, liquid mirror, low-cost telescope at a \$3,000 budget.

## **MEM-32 COOPERATIVE MANIPULATION WITH HUMANOID ROBOTS**

**Advisor:** *Dr. M. Ani Hsieh*

Team:

Devashish Bhargava	Mechanical Engineering
Zhijian Liang	Mechanical Engineering
Christine Nolan	Mechanical Engineering
Wei Ye	Electrical Engineering
Yongping Zhou	Mechanical Engineering

The objective of this project is to design an advanced control and command architecture for autonomous cooperative manipulation. This high-level control strategy enables one autonomous mobile manipulator to cooperatively transport an object with another robot or manipulator. This was achieved by developing a command and control architecture that enables the two-robot team to: 1) cooperatively carry a large object that each robot individually cannot carry; and 2) transport the object from a start location to a goal location in the workspace. In this framework, robot and object positions and orientations are captured by an overhead camera network. This information is used to develop closed-loop feedback control strategies to enable the manipulators to collectively move the object to a desired goal location while following a trajectory. The contribution of this work lies in the development of a framework that enables cooperative manipulation between two autonomous mobile manipulators.



## **MEM-33 WRIST STIFFNESS AND STRENGTH TESTER**

**Advisors:**     *Dr. Sorin Siegler, Dr. Allon Guez, Zac Waldman*

Team:

Zachary Jones	Mechanical Engineering
John Pang	Computer Engineering
Jonathan Huynh	Mechanical Engineering

Parkinson's disease is a movement disorder that affects more than 6 million people worldwide. It is primarily treated with pharmaceutical drugs, leading to an unsustainable treatment regimen due to development of drug tolerance. Deep brain stimulation (DBS) is an alternative form of treatment that involves implanting electrodes into the brain to mitigate abnormal nerve signals. Suboptimal placement of the electrodes can result in severe side effects. Current methods to optimize electrode placement are entirely subjective. The Wrist Stiffness and Strength Tester (WSST) was developed to objectively optimize electrode placement in DBS. The WSST is capable of characterizing multiple biomechanical properties of the wrist, including passive and active range of motion (ROM) and passive stiffness. The WSST is a computer controlled linkage capable of automatically moving the wrist throughout its full ROM. It optimizes placement of electrodes in DBS by determining the position that minimizes the passive stiffness of the wrist

## **MEM-34 PARTIAL-MOBILITY SHOULDER BRACE**

**Advisor:**     *Dr. Sorin Siegler*

Team:

Matthew Annen	Mechanical Engineering
Christina Nikolos	Biomedical Engineering
Nimisha Parikh	Biomedical Engineering
John Piotrowski	Mechanical Engineering
Brynn Thallner	Biomedical Engineering

Various surgical pathologies such as a rotator cuff tear, shoulder dislocation, rheumatoid arthritis, and frozen shoulder require a patient to undergo extensive surgical treatment as well as rehabilitation. Rehabilitation is a key factor in ensuring that the patient regains full range of motion of the glenohumeral joint. If the shoulder injury is severe enough, surgery may be required for the patient with a stringent rehabilitation procedure after. There are three planes of linear motion the shoulder can move: flexion/extension, abduction/adduction, and internal/external rotation. Different rehabilitation plans require that the patient move the glenohumeral joint solely in one plane while fixing motion in the other. This may be required to ensure that no strain is placed on the site of the injury, while still allowing the arm to regain strength. Although immobilization is a common rehabilitation practice after any type of shoulder surgery, it may be beneficial to allow motion of the shoulder in certain planes of motion to ensure that arm can fully regain range of motion and muscle strength. Thus, the goal of this senior project is to develop a partial mobility shoulder brace to allow for select motions of the shoulder as well as providing rehabilitation of the shoulder through applying Therabands™ to the device to promote healing. The aim is to create a lightweight, breathable, and durable device that allows the patient to slowly regain full range of motion of the shoulder. The device will be tested by following specific physical therapy rehabilitation procedures to ensure that the manipulations and exercises required can be performed using the partial mobility splint.

## **MEM-35 EFFICIENT GREY WATER SYSTEM**

**Advisor:**     *Dr. Sabrina Spatari*

Team:

William Clark	Mechanical Engineering
Abhinav Kumud	Mechanical Engineering
Jeses Muttter	Mechanical Engineering
Jim Rish	Mechanical Engineering
Kyle Trotter	Mechanical Engineering

The goals of this project revolved around creating a very efficient grey water system for the Drexel Smart House. This system incorporates components that can be used as a learning/research tool for the residents of the smart house by allowing them to view metered data about the system performance. The system incorporates a net zero water usage model through harvesting and filtering rainwater. By directing and separating water with harmful contaminants to black water basins, rainwater is used to supply the freshwater needs of the Smart House. Contaminates and harmful bacteria buildup in the grey water storage basins are avoided by oxygenating and circulating the water supply through living and microbial filtration beds. Two alternatives for hot water supply and storage were considered for the design; a point of use system, and a waste oil fueled water heater. The waste oil heater uses waste kitchen oils from Drexel's on campus dining to fuel the water heating device. All fixtures, pumps, and feed lines were optimized for peak efficiency given the design and usage criteria outlined for the project.

## **MEM-36 DESIGN AND FABRICATION OF AN ELECTROSTATIC AUTOFOCUSING NANOPRINTER**

**Advisor:**     *Dr. Ying Sun*

Team:

Vedant Bhootra	Mechanical Engineering
Meltem Celik	Mechanical Engineering
Nikhil Gampa	Mechanical Engineering
Nakul Jain	Mechanical Engineering
Michael Martin	Mechanical Engineering

Exponential growth in technology demands new and efficient ways to package and fabricate next generation electronics. Nanotechnology is a key technology for the future, with applications including medicine, biomaterials, electronics and energy production. Our stakeholders have made investments for the development of an electrostatic autofocusing nanoprinter which would be capable of making flexible, inexpensive, on demand and scalable nanostructures. The team objective was to make significant progress in researching and applying enhancements for a preexisting nanoprinter setup. The primary modifications that were investigated included the addition of third axis of motion for the printing nozzle, a device capable of detecting nanodroplets ejected from the nozzle, and a printing fluid able to reproduce desirable results. Our progress has included the identification of a linear actuator that will serve as the third axis of the nozzle, a novel, yet untested detection device, and a series of fluids that have yielded promising results.

*Sponsor: NSF, Drexel Complex Fluids and Multiphase Transport Lab*

**MEM-37**  
**THE DESIGN AND FABRICATION OF A FORMULA SAE CHASSIS**

**Advisor:**     ***Dr. Tein-Min Tan***

Team:  
John Guanga                    Mechanical Engineering  
Timothy Lombardi            Mechanical Engineering  
Timothy Reinhart            Mechanical Engineering  
Selin Sahici                   Mechanical Engineering  
Kevin Werner                 Mechanical Engineering

In response to the growing needs of Drexel’s Formula SAE and Formula Hybrid SAE teams, a new chassis was developed for their formula cars in the 2014 season. By targeting an improved rigidity per unit mass and cross team flexibility for electric or internal combustion power trains, while maintaining in house manufacturability by the student teams, a hybridized composite monocoque and steel space frame was developed. Refined further though theoretical modeling of the composite structures, physical laminate testing, and computer design and analysis, a central carbon fiber reinforced cockpit structure has taken the place of the previous steel crash structures while a small bolt-on subframe provides the needed level of variation and adaptability to a constantly evolving racecar with minimal added weight.

*Sponsor: Drexel Racing*

**MEM-38**  
**STERN TUBE SEAL LEAKAGE SUPPRESSOR**

**Advisors:**     ***Dr. Tein-Min Tan, Dr. Christopher Peters***

Team:  
Zack Albino                    Mechanical Engineering  
Tim Andrews                  Mechanical Engineering  
Greg Dobbs                    Mechanical Engineering  
James Murray                 Mechanical Engineering

A stern tube connects the inboard and outboard of a ship and provides a passageway for the propulsion shaft to pass through the hull of the ship. The function of the stern tube seal is to prevent the ingress of seawater into the ship’s spaces through this passageway. On a particular Navy ship, the bolts that mount the stern tube seal housing flange to the bulkhead of the ship are expected to shear when the ship is exposed to a shock event, causing the ship to experience flooding through the stern tube cavity. It incorporates a rubber bellows design that will be permanently installed and can accommodate any displacement of the shaft. This design negates the need for manual activation allowing the crew the necessary time to handle more pressing matters. A quarter-scale model was developed and tested for a period of seven days to ensure full compliance of Naval standards.

*Sponsor: U.S. Navy*

## **MEM-39 SUMPLISTIC**

**Advisor:**     *Dr. Tein-Min Tan*

Team:

Dan Broughton	Mechanical Engineering
Sean Horner	Mechanical Engineering
Nicholas Manzi	Mechanical Engineering
Daniel Sellitto	Mechanical Engineering

Owning and maintaining a saltwater aquarium is a complicated task requiring multiple forms of filtration devices as well as continuous monitoring and cleaning. There is currently no off the shelf product capable of maintaining a habitable saltwater environment for marine aquatic life and coral growth. In order to own a sustainable saltwater aquarium, one must assemble their own filtration system from multiple components. Successfully sizing pumps, filters, and monitoring equipment for a saltwater aquarium requires considerable knowledge, and is a daunting task to first time hobbyists. Beyond the initial complexity, traditional DIY solutions require an overwhelming amount of periodic cleaning and maintenance. The team behind Sumplistic has alleviated these issues by designing an all-in-one system that integrates all essential filtration equipment, pumps, and monitoring instrumentation required to own a healthy and low maintenance saltwater aquarium into a single compact enclosure.

## **MEM-40 A COOPERATIVE FLEET OF BIO-INSPIRED AUTONOMOUS UNDERWATER VEHICLES**

**Advisor:**     *Dr. James Tangorra*

Team:

Eric Cristofalo	Mechanical Engineering
Hans Formon	Electrical Engineering
Jared Marks	Mechanical Engineering

Current AUVs often involve propeller driven, torpedo-like vehicles which operate well for a small set of target missions. However, these vehicles lack the sophisticated swimming abilities demonstrated by aquatic organisms. Furthermore, use cases often involve only a single vehicle. Consequently, there is a lack of a more generic platform which expands the design space of AUVs by incorporating bio-inspiration and multi-robot collaboration. A team from the Laboratory for Biological Systems Analysis has developed a fleet of unmanned and semi-autonomous underwater robots as a platform for the implementation of both bio-inspired propulsion and collaborative robotics research. The completed system allows for a number of experimental configurations utilizing pectoral and/or caudal fins to propel the fish. Electronic systems provide ample processing power, inertial measurements for closed-loop control, and an external communication system. A modular design also ensures that the platform can expand in the future.

*Sponsor: LBSA (Laboratory for Biological Systems Analysis)*

## **MEM-41**

### **SUAS STUDENT UNMANNED AIR SYSTEMS INTERNATIONAL COMPETITION AIRFRAME AND GIMBAL TEAM**

**Advisor:**      *Dr. Ajmal Yousuff*

Team:

Taylor Brophy	Mechanical Engineering
Colin Eggert-Crowe	Mechanical Engineering
Nathanael Itescu	Mechanical Engineering
David Kumpf	Mechanical Engineering
Matthew Teter	Mechanical Engineering

The Student Unmanned Aerial Systems competition is run every year by the Association for Unmanned Vehicle Systems International Seafarer chapter. The object of this competition was of this to autonomously locate and identify characteristics of several alphanumeric glyphs placed at unknown locations on the ground. This exercise was designed to be a simulation of using drone planes to simulate a post-disaster, large-area, search-and-rescue operation. Drexel University's entry into this competition was a collaboration of three design teams including a communications team, a software team, and an this team with duties and responsibilities all related to the airframe and the gimbal-camera assembly. Our airframe design included a fuselage and wings made from wire-cut foam and a sturdy carbon fiber skeleton. To hold our camera we integrated a roll-pitch gimbal attached to the bottom of our aircraft. The aircraft must be stable for high quality photos and have a flight time long enough to complete the competition.

*Sponsor: National Space Grant Consortium*

## **MEM-42**

### **SUAS SOFTWARE TEAM**

**Advisor:**      *Dr. Ajmal Yousuff*

Team:

Ken Aston	Mechanical Engineering
Jeremy Barr	Mechanical Engineering
Joshua Geating	Mechanical Engineering
Daniel Jones	Mechanical Engineering

Software was developed for a Surveillance UAV system, both on-board and on-ground, to compete in an international competition in which UAVs autonomously map and locate target glyphs on the ground. The on-board software consists first of a C++ program for the onboard Embedded Single Board Computer (ESBC) to send commands to the gimbal, take photographs, and perform onboard computer vision processing. It also includes an Arduino program written for a corresponding microcontroller to send and receive data from the gimbal components. The ground control station software consists of three software components. The first is a C++ program responsible for displaying photographs taken from the onboard camera, manually tagging images, and displaying results to the judges. Secondly is a more in depth computer vision program to analyze images and autonomously locate targets for the competition. Lastly is autopilot software to communicate with the UAV and receive telemetry.

*Sponsor: National Space Grant Consortia*

**MEM-43**  
**SUAS AUTOMATED HIGH ALTITUDE SCOUT AIRCRAFT**

**Advisor:**     ***Dr. Ajmal Yousuff***

Team:

Derek Feverston	Mechanical Engineering
Melissa Hudak	Mechanical Engineering
Reuben Krutz	Electrical Engineering
Nur Atiqah Shahrin	Mechanical Engineering
Andrew Zwarych	Electrical Engineering

The versatility of unmanned aerial vehicles (UAV's) has made them a popular decision in both public and private sectors. One application still to see much influence from UAV's is high altitude data collection. Using previously established high altitude balloon techniques, this project supports a design for delivering a set of small UAV's to the upper atmosphere for collecting photographic, temperature, and pressure data before guiding themselves back to a preset location. To accomplish this task, an Arduino based guidance system was incorporated into a compactable aircraft frame, giving the system both electronic and physical flexibility. The crucial characteristics of the aircraft were verified through independent part validation, simulated flight conditions, and low level flights. The project demonstrates a cost saving, adaptable, and reusable system for use in military, scientific, or even off-world endeavors.

*Sponsor: Drexel Space Systems Laboratory*

**MEM-45**  
**SUAS AERIAL SURVEILLANCE COMPETITION: COMMUNICATIONS TEAM**

**Advisor:**     ***Dr. Ajmal Yousuff***

Team:

Joseph Diaz	Electrical Engineering
Joby Mathew	Electrical Engineering
Nick Walker	Electrical Engineering

The Drexel Student Unmanned Aerial Systems (SUAS) team has developed a solution to the communication problems posed by the Association for Unmanned Vehicle Systems International (AUVSI). The SUAS competition involves the design of a fully autonomous vehicle which is capable of navigating waypoint paths and search areas while locating, and identifying, targets of interest based on characteristics such as shape and color. The support of the software and airframe teams allowed the communications team to focus on the challenges of establishing a reliable connection with a mobile system. By partnering with the National Space Grant Consortium the communications team was able to design a system which was capable of maintaining long range communication with an autonomous aircraft over multiple wireless channels.

*Sponsor: National Space Grant Consortium*

## **MSE-01**

### **THERMOMECHANICAL PROCESSING OF AA5083 AND THE RESULTANT IMPACT ON CORROSION RESISTANCE**

**Advisors:** *Dr. Mitra Taheri, Dr. William J. Golumbfskie (Naval Surface Warfare Center, Carderock Division)*

Team:

Jonathan Andrus

Materials Science and Engineering

Naval ships demand a strong, lightweight and corrosion resistant material for their hull plating. AA5083 is used as hull plating but suffers from the formation of a deleterious secondary phase over time which makes the plate susceptible to intergranular stress corrosion cracking. Cold-rolling to reductions on the order of 5% in total thickness have shown an increase in corrosion resistance. This work, through the use of EBSD and ASTM G67 NMLT, shows a correlation between grain size and corrosion resistance. Additionally, this work also correlates grains size with yield strength, ultimate tensile strength and elongation through the use of in-situ SEM tensile testing. By correlating grain size with corrosion resistance and mechanical properties it is possible to select the appropriate target grain size of the hull plate material to improve its resistance to intergranular stress corrosion cracking.

*Sponsor: Naval Surface Warfare Center – Carderock Division*

## **MSE-02**

### **MONITORING AND IDENTIFICATION OF PROGRESSIVE DAMAGE IN AEROSPACE COMPOSITES USING NON DESTRUCTIVE TESTING**

**Advisors:** *Dr. Antonios Zavaliangos, Dr. Antonios Kontsos, MEM*

Team:

Utku Guclu

Materials Science and Engineering

The goal is to determine the failure mechanisms and predict the remaining life of fiber-metal laminates using mechanical testing coupled with Non-Destructive Testing (NDT) techniques. These techniques are Acoustic Emission (AE) and Digital Image Correlation (DIC). They are being used in a hybrid setup concurrent with mechanical testing. Data collected from each method will complement each other and provide crucial correlations to better characterize failure mechanisms of the material. Specifically, Glare 2A, a composite material composed of Al 2024 and s-type Glass fiber-epoxy is being studied. To investigate the failure mechanisms of Glare, a series of tensile and fatigue tests on Aluminum and Fiberglass have been carried out to establish a baseline understanding of the effects of these components on the overall mechanical strength of the composite. Finally, a series of tensile and fatigue tests are being run on Glare to investigate the initiation and development of its failure mechanisms.

### **MSE-03**

#### **THE EFFECT OF NICKEL DISTRIBUTION ON THE HARDENABILITY OF POWDER METAL COMPACTS**

**Advisors:** *Dr. Mitra Taheri; Dr. Bruce Lindsley, Hoeganaes Corporation*

Team:

Alicia Kriete

Materials Science and Engineering

The alloying method used has a significant impact on the properties of sintered powder metal (PM) parts. The effect of nickel distribution on the hardenability of a Fe-0.5%Mo-1.8%Ni alloy was studied, using both pre-alloys and hybrid alloys. While pre-alloys have a homogeneous composition and harden more easily, they also have poor compressibility. This represents a major drawback in industry where more highly compressible powders are desirable. Hybrid alloy steels contain admixed nickel and exhibit superior compressibility behavior. Sintering conditions, however, will influence the distribution of nickel in the sintered compact, and therefore affect the hardenability of hybrid alloy parts. Increasing time and temperature are expected to improve the hardenability of hybrid alloy parts and will enable them to behave more like pre-alloys during subsequent heat treatment. Sintered and heat-treated samples were microstructurally characterized using light optical microscopy, scanning electron microscopy (SEM) and energy dispersive x-ray spectroscopy (EDS).

*Sponsor: Hoeganaes Corporation*

### **MSE-04**

#### **DEVELOPMENT OF QUANTUM DOT INTEGRATED LIGHT-EMITTING DIODES FOR SOLID-STATE WHITE-LIGHT APPLICATIONS**

**Advisors:** *Dr. Wei-Heng Shih; Dr. Wan Young Shih, BMES*

Team:

Yen-Ming Lu

Materials Science and Engineering

Quantum dots (QDs) have been integrated with light emitting diodes (LEDs) to generate white light. Unlike normal LED emission, which generally consists of a single wavelength, white light emission requires broad visible light spectral emission. Quantum dots excited by LED light source emit light with wavelengths providing spectra that LEDs do not have. Aqueous quantum dots (AQDs) developed can be synthesized easily and do not require rare earth metals like most white-light LED phosphors. More importantly, AQDs can produce spectra of wide bandwidth thus white light can be generated with a single kind of AQDs. Consequently, it is expected that AQD-integrated LED white light will be more uniform and low cost. Experiments demonstrated AQD phosphors integrated with blue LEDs (465 nm) capable of generating white light with a correlated color temperature of 6500 K. Results indicated that AQD phosphor integrated LEDs are capable of generating white light with various correlated color temperatures.



## **MSE-05**

### **CORE-CLAD ELECTROSPUN FIBERS FOR CONTROLLED DRUG RELEASE APPLICATIONS**

**Advisor:**     ***Dr. Caroline L. Schauer***

Team:

Ashley Moretti	Materials Science and Engineering
Elizabeth Poys	Materials Science and Engineering
Elizabeth Toby	Materials Science and Engineering

Transdermal patches are convenient alternatives to oral medication delivery, due to their target area release mechanism. Controlling the drug release rate from the patch is essential for safe and effective delivery. Coaxial electrospinning is a new and versatile polymer processing technique that produces core-clad submicron fibers with high drug loading ability and sustained release. This versatility allows for medication delivery based on a patient's need. Material selection using natural and synthetic polymers that were coaxially electrospun were loaded first with model esters and then with prednisolone to understand release rate mechanisms. Fiber morphology was characterized via SEM and release rates from the fiber core were monitored using ultraviolet-visible spectroscopy. These results support the viability of coaxially electrospun fiber mats as alternatives to transdermal drug patches.

## **MSE-06**

### **ADSORPTION OF ANTIBIOTICS ONTO NANODIAMOND PLATFORMS**

**Advisors:**     ***Dr. Yury Gogotsi, Dr. Vadym Mochalin***

Team:

Amanda Pentecost	Materials Science and Engineering
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Nanodiamond (ND) is an attractive material for use as a drug delivery vehicle because of its small particle size (~5nm), biocompatibility, and most importantly, its rich, tailorable surface chemistry. Although the potential for NDs in delivery and sustained release of drugs has been recently demonstrated, very little is known about the details of adsorption/desorption equilibria of these and other drugs on/from NDs with different surface chemistries and agglomeration size. In this study, the adsorption activity of two different antibiotics, including tetracycline and polymyxin B, onto different types of modified ND was analyzed, and their methods of adsorption discerned (e.g. single or multilayer). Additionally, the desorption kinetics of these ND-drug complexes were monitored. These studies will allow for the design of a ND-platform drug delivery system that allows for targeted delivery and triggered release.

*Sponsor: sp3 Inc. Diamond Technologies*



## **BME-01**

### **PEPTIDE-BASED DELIVERY SYSTEM USED FOR TAGGING SYK TYROSINE KINASE BIOMARKER IN SKIN CANCER AND DEVELOPMENT OF A HYPERSPECTRAL IMAGING DEVICE TO DETECT THE BIOMARKER**

**Advisor:**      *Mr. Andres Kriete*

Team:

Bri Galligan	Biomedical Engineering
Ryan Riling	Biomedical Engineering
Jessica Stufflet	Biomedical Engineering
Aparna Swarup	Biomedical Engineering

In early stages of basal cell carcinoma (BCC) and squamous cell carcinoma (SCC) lesions, Spleen Tyrosine Kinase (Syk) levels are elevated. Currently, there is no quantitative, non-invasive method for detecting the Syk biomarker that is present in skin cancer.

We propose to design a non-invasive diagnostic system consisting of a topical cream formulation and a hyperspectral imaging device. The cream contains tags that are comprised of Syk-specific peptides conjugated to fluorescent dye molecules. These tags are encapsulated in liposomes and transported through the skin via diffusion. The tags are then released and bind to Syk, allowing the fluorophore to fluoresce. The hyperspectral imaging device excites the fluorophore using the appropriate wavelength and quantifies the fluorescence. Overall, the diagnostic system quantifies the amount of Syk and identifies elevated levels, which indicate early tumor induction and progression in BCC and SCC.

The final design needed to detect at least a 3:1 fluorescence to background intensity to ensure a true reading. Additionally, the Syk-specific dye-peptide complex must bind to the Syk protein with at least a 50% binding efficiency.

*Sponsor: Coulter Foundation*

## **BME-02**

### **BIOMIMETIC AGGREGAN IN THE TREATMENT OF URINARY INCONTINENCE**

**Advisor:**      *Dr. Michele Marcolongo, MSE*

Team:

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Urinary incontinence is a prevalent problem in post-menopausal women, affecting about 13.1 million women aged 40 to 60 years in the U.S. Current treatments such as narrowing the urethra lumen with bulking agents are somewhat effective, but do not directly treat the cause. Incontinence in women is associated with a stiffening of the urethra and a decreased in urethra volume, making the urethra more difficult to close. In this project, Biomimetic Aggrecan (BA), a synthetic proteoglycan, is proposed to treat urinary incontinence. Our goal is to design a BA-based material to be injected into the urethra, which increases the water content of the tissue. The design criteria for our prototype is to have a 20% to 30% decrease in tissue stiffness and a 25% to 35% increase in tissue volume when injected. Changes in stiffness and volume were measured using mechanical tensile testing and MicroCT scans, respectively. Our prototype from the project is 50 mg of BA dissolved in 1 ml of Phosphate Buffer Saline (PBS) solution.

### **BME-03**

#### **FLOW CHAMBER TO STUDY THE EFFECTS OF INTERSTITIAL FLUID FLOW ON TUMOR CELL MIGRATION**

**Advisor:**      *Dr. Adrian Shieh*

Team:

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Interstitial fluid flow, the local movement of fluids within hydrated tissues, has been implicated in tumor cell migration. Thus, in a lab that researches the effects of mechanical forces on cancer progression, there is a need to study the relationship between interstitial fluid flow and cell migration. The following are to be evaluated as design criteria: 1) fluid flow must be at a controlled physiologically relevant range of 0.1 to 10  $\mu\text{m/s}$  2) the supplied flow should be in increments no greater than 0.1  $\mu\text{m/s}$  to prevent cellular response 3) identify regions of constant local flow velocity using time lapse microscopy. To fulfill this, we built a flow chamber that can subject cells embedded in a collagen gel to a physiologically relevant, measured, and controllable flow. The prototype is a hexagonal flow chamber in which we can detect the local flow velocities using the release profile of fluorescent dye encapsulated gelatin microspheres. The flow will be generated by a programmable syringe pump connected the chamber by tubing.

### **BME-04**

#### **A HAND EXOSKELETON FOR SPASTIC CLENCHED FIST DEFORMITY IN STROKE PATIENTS**

**Advisors:**      *Dr. Nathaniel Mayer, Moss Rehabilitation Hospital*

Team:

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Spastically clenched fist patients have very limited ability to perform daily activities. There is a need to improve the effectiveness of therapeutic devices to improve the patients' functionality and range of motion in their hand. The objective of this is to design and create a cable based exoskeleton that will assist in mechanically extending the patients fingers through the full range of motion in each joint. This requires a range of: 0-80° in the distal interphalangeal joint, 0-90° in the proximal interphalangeal joint, and 0-100° in the metacarpophalangeal joint. The exoskeleton will respond to a user initiated electromyography signal recorded from the extensor digitorum communis muscle and a threshold value set by the patient. Threshold surpassing signals activates a motor that pulls the fingers into extension, as signals below threshold will deactivates the actuator and relieves the tension on the cables. This results in a "forced use" type of therapy and a coupled contraction of the extending muscle to provide potential for neuroplasticity.

## **BME-05**

### **PORTABLE BLOOD PRESSURE & PULSE RATE SENSOR FOR DETECTING HEAT ILLNESSES IN ATHLETES**

**Advisors:** *Dr. Marek Swoboda; Dr. Suryadevara Basavaiah, ECE*

Team:

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Exertional heat stroke (EHS) is the third leading cause of death in all-level athletes from middle school to professional. There are no definite evidences that a mild heat illness symptom (e.g. heat rash) and heat exhaustion will fully evolve into EHS. Therefore, there is a need to develop a system that will detect oncoming heat exhaustion before developing into EHS in participating athletes. The solution calls for a portable blood pressure (BP) and pulse rate (PR) sensor that will detect the changes in both BP and PR levels before reaching thresholds of EHS. This will be accomplished by constructing a device consisting of three parts. A ring sensor will detect the pressure of the artery in the finger. The output signal will be sent to the wristband unit for signal conditioning. The signal will be sent to a computer wirelessly from the wristband for MATLAB analysis.

## **BME-06**

### **ENGINEERING A BDNF GRADIENT IN SITU FOR DIRECTIONAL AXON REGENERATION AFTER SPINAL CORD INJURY**

**Advisors:** *Dr. Yinghui Zhong, Dr. Karen Moxon*

Team:

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BDNF (brain derived neurotrophic factor) has been demonstrated to promote axonal regrowth within an injured spinal cord. However, unguided growth resulted in axonal sprouting in multiple directions thus preventing reconstruction of functional synapses. A protein gradient has shown to guide axonal growth. BDNF between 50 and 500 ng/mL is required to trigger axonal growth without inducing cytotoxicity. Our solution is to create hydrogel loaded with nanoparticles entrapped with lysozyme, a BDNF model protein, which delivers the drug and establishes a linear protein gradient in situ within the injury site. A mathematical model, based on the derivation of Fick's second law, estimates the release. The nanoparticle-laden hydrogel will be placed on top of a spinal cord mimic fabricated with agarose to allow proteins to diffuse. Presence of protein gradient will be detected by fluorescence microscopy after which the intensity will be measured by a MATLAB program.

## **BME-07**

### **TRI-MODE BAG-VALVE-MASK RESUSCITATION SYSTEM FOR PEDIATRIC PATIENTS**

***Advisors: Dr. Sriram Balasubramanian; Dr. Vinay Nadkarni, CHOP; Natalie Napolitano, CHOP***

Team:

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Currently, there exist two types of disposable bag-valve-mask (BVM) resuscitation systems utilized in the resuscitation of pediatric patients: the flow-inflating and self-inflating systems. The self-inflating system can operate with or without gas, while the flow-inflating system can only operate with a gas connection. This project aims to create a device that combines the functionality of both BVM systems, thus minimizing the time required to switch. The design specifications outline the requirements for delivered volume and pressure to the patient, inspiratory and expiratory resistance, and fraction of inspired oxygen. Also, the time required to switch between the two systems must be less than one minute, and the user interface must respond to average female grip strength. The design is constrained by a certain weight and size, preparation time out of package must be less than one minute, compatible with universal fittings, and the minimum number of operators must be one.

## **BME-08**

### **A BI-LAYER HYDROGEL WOUND DRESSING FOR OPTIMAL EXUDATE ABSORPTION AND SILVER/COPPER RELEASE**

***Advisor: Dr. Kara Spiller***

Team:

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Due to the large area of their wounds and the high frequency of dressing changes, burn patients have a significant risk of bacterial infection. In addition, these patients often experience scarring as a result of a prolonged healing process. Maintenance of a moist wound bed free from bacteria is critical to proper wound healing, however the amount of fluid exuded from a wound varies greatly from patient to patient and from wound to wound. Currently available wound dressings frequently leave the wound bed too wet or too dry and do not actively combat infection. To meet this need, the team designed a bi-layer gelatin hydrogel wound dressing that maintains 0.42-0.84 grams of exudate per square centimeter of tissue, the range identified as ideal for proper healing. The dressing actively combats bacterial infection by releasing silver and copper ions, two potent antibacterial agents, into the wound bed.

## **BME-09**

### **CALIBRATION ALGORITHM AND ELECTRODE ARRAY FOR EMG OF PROSTHETIC GRABBING HAND**

**Advisors:** *Dr. Hasan Ayaz*

Team:

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Many prosthetics have been designed for people who have lost one or both of their hands. However, the existing designs offer too little functionality, must be specialized for an individual user, or are difficult to learn how to use. There exists a need for a system that acquires control signals from patients with hand amputations, with the capability to differentiate between intended individual finger movements. The objective of this project was to design a non-invasive prosthetic controller that can successfully operate individual digits from an array of sensors that may be placed differently on a day-to-day or patient-to-patient basis. The designed solution consists of a calibration algorithm using k-means clustering and a classification algorithm to identify the intended movements. The team designed a supplemental electrode sleeve to acquire the necessary EMG signals. The system is intended to be paired with a prosthetic hand with functional fingers and movement based on EMG data input.

## **BME-10**

### **THERAPEUTIC ULTRASOUND APPLICATION DEVICE FOR CHRONIC VENOUS ULCERS**

**Advisors:** *Dr. Peter Lewin, Joshua Samuels, Youhan Sunny, Christopher Bawiec*

Team:

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Due to their irregular shapes, depths, and contoured surfaces, venous leg ulcer wounds are difficult to treat with current ultrasound devices. Therefore, there is a need for a therapeutic ultrasound delivering device that contours to unique ulcer shapes while providing uniform ultrasound to facilitate the healing process. Our ultrasound application device will comprise of three components: a sterile wound dressing, a modular grid housed within a wearable strap for single transducer element(s) insertion, and a LabVIEW Graphical User Interface (GUI) program to manipulate controls over transduction of ultrasound. Our proposed application device for therapeutic ultrasound treatment presents a prototype that will be applicable in clinical settings to treating chronic wounds while reducing treatment time and expenditures on hospital resources.

## **BME- 11**

### **CPR INTELBOARD FOR USE DURING CADIOPULMONARY RESUSCITATION**

***Advisors: Dr. Sriram Balasubramanian; Dr. Matthew Maltese, CHOP***

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Accurate estimation of sternum-to-spine displacement during in-hospital Cardiopulmonary Resuscitation (CPR) is hindered by mattress deformation. Common practice is to place a backboard between the patient and the mattress but deformation still ranges from 37 to 52mm on Intensive Care Unit hospital beds and 42 to 47mm on stretchers. Mattress deformation leads to an underestimation of chest compression depth, which should be 51mm; a guideline set by the American Heart Association. Therefore, the objective is to design a smart backboard that is able to measure the displacement of the chest and the backboard on the mattress in real time while providing users with live feedback about true compression depth. The IntelaBoard will track a rate of 100 compressions/minute as well as a depth of  $44.5 \pm 6.35$ mm. The current prototype uses four digital accelerometers, three mounted on a polypropylene plastic backboard, and one housed in a sleeve placed on the patient's chest during compressions.

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